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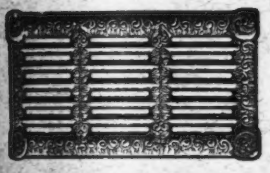

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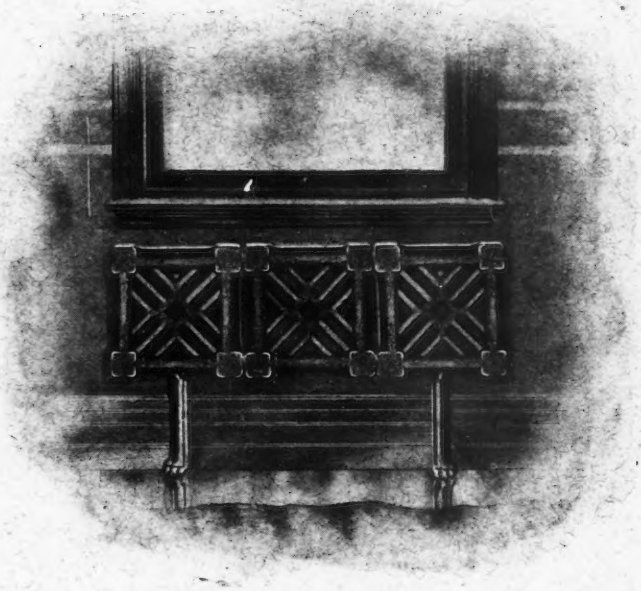

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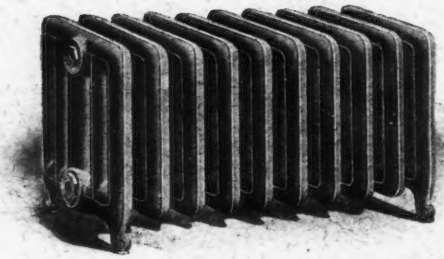

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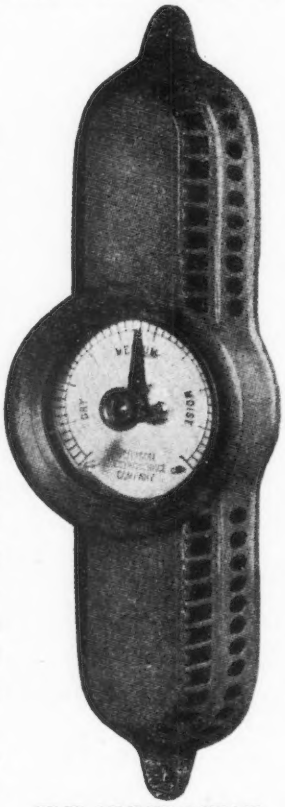

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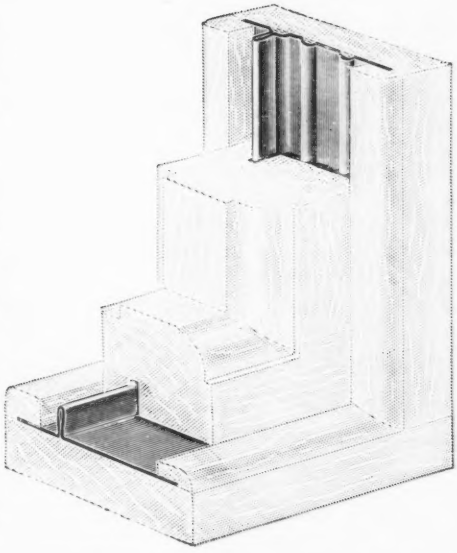
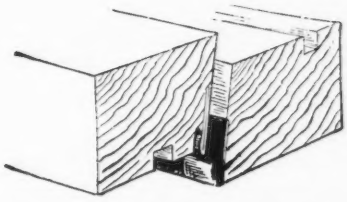


CHAMBERLIN "CORRUGATED" METAL WEATHER STRIP, SHOWN IN PLACE ON A WINDOW SASH



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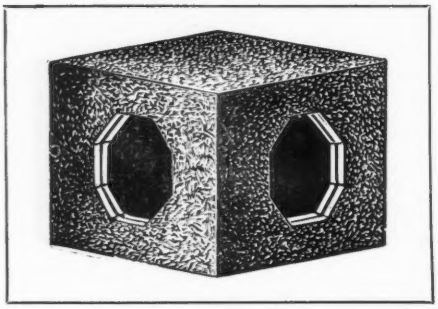
Steam Economy Talks—3



¶ This cut illustrates the manner of covering tees andelbows. The top is put on with screws, so that it can be easily and quickly removed when necessary.

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The Heating and Ventilating Magazine

VOL. V No. 9

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SEE SWEET'S INDEX

THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK SEPTEMBER, 1908

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Twelfth Semi-Annual Meeting, Niagara Falls, July 24-25, 1908

(Concluded)

Reasons Why The Science of Heating and Ventilation Should Be Observed

BY PROF. J. D. HOFFMAN

(This paper was published in THE HEATING AND VENTILATING MAGAZINE *for August, 1908.)*

DISCUSSION

MR. CHEW—Furnace manufacturers are at present engaged in an uplifting movement. The Federal Furnace League is having a handbook prepared giving rules, etc., for hot air furnace heating. Some sort of rules must be given in the future to the men who are going to do the furnace business. These men, unfortunately, have not the influence with the architect and others who design the buildings that will induce the latter to change their methods of design.

MR. G. D. HOFFMAN—There is an old saying that you can lead a horse to water but you cannot make him drink. I know of an instance where very carefully-prepared instructions were furnished for the proper installation of certain materials. We put the directions in every one of the boxes containing this apparatus. The contractor said he was having considerable trouble in making the system work. In the course of my talk with the man I asked him where were the directions that we furnished. "Why," he said, "I don't know anything about any directions." Well, we went up to the room where he had taken out the valve and all over the floor were these directions. I picked up one and said, "Here is an answer to the very question you were asking." No attention had been paid to the directions. The result was the man had a great deal of his work to do over again. The architect had specified how this job was to be done, what appliances were to be used and had gone more or less into detail, but no supervision was given that job in any way. I would like to know how we are going to compel the contractor or steam fitter to absorb a little of the information that those who are specialists have taken years to prepare.

MR. JAS. H. DAVIS—See that the engineers superintend their work.

MR. JOSEPH A. GORTON—I find supervision varies in different sections. For instance, a man laid out a certain job requiring certain specialties. The steam fitter took the plans to bid on the job. It was pointed out to him that the job was to be done in just the manner prescribed. He rolled up

the plans, took them to his office and put them in his desk. Then he went to work, an ordinary job, as he understood it, following out his own ideas. When the job was finished, it did not work properly and he was immediately sent for. He was asked where the plans were. "I haven't seen any plans," he said. At last he went to his desk and pulled out the roll of plans. There everything was plainly indicated, but the only thing he followed was the location of the radiators. The result was that nearly all the piping had to be ripped out and set up again and the boiler taken down and a pit dug for it, 18 in. deep. Now, why is it? In other engineering work, plans and specifications are followed to the letter. We have had a good deal of trouble with the indifference of the steam fitter.

PROF. J. D. HOFFMAN—If you touch a man's pocketbook, you are going to set him thinking quicker than in any other way. If a contractor deliberately ignores instructions, make him take the work out and do it over again. Too many times a man is permitted to pipe up a job and it is allowed to stand as a defective piece of work. When a job is done incorrectly and not according to plans and specifications, make the contractor pull it out and make it right. He has to do it.

MR. C. E. OLDACRE—The manufacturer is the greatest disseminator of knowledge concerning heating apparatus there is. He is the man who gives out to the general public the rating his apparatus is supposed to have. The heating contractor is the man who is to fulfill the contract. The architect is the man who stands to the front and is supposed to be responsible for the plans. Many architects are designers, but when it comes to the question of mechanical details, they have to fall back on the heating engineer. The heating engineer, as an engineer, is not as well recognized as he should be.

SECRETARY W. M. MACKAY—It seems to me the man who makes the plans is the best man to interpret them. The heating engineer should feel it necessary to furnish supervision over work being done according to his plans and specifications and condemn any work, if necessary, during its progress and not at its completion.

Mr. Oldacre speaks of the architects. Our society, some years ago, appointed a committee to confer with a committee appointed by the American Institute of Architects. They were well received by that society and ideas were given and taken. The best architects in the United States today recognize the necessity of employing engineers outside of their profession when it is necessary in the construction of a building. The architects of the United States are an intelligent body of men and will work with sense and reason with any other engineering body. So it is wrong for us to allow anything to go into our records that would give a different impression.

A Hot Air Furnace in a House Without a Cellar

BY R. S. THOMPSON

(*This paper was published in* THE HEATING AND VENTILATING MAGAZINE *for August.*)

MR. CHEW—I assume a majority of people doubt that you can successfully heat with a furnace on the same floor as the part of the building to be heated. In the system described by Mr. Thompson there was no cold air supply installed. He says he had return air direct from the various rooms and that it worked satisfactorily so that there was no necessity for putting in a cold air supply.

MR. A. O. JONES—In defense of Mr. Thompson's plan, I will say that I have found it possible to heat rooms near the furnace on the same level by locating the inlet at the top of the room and the outlet at the bottom.

PRESIDENT JAMES MACKAY—The topic, No. 1, "Rules in Furnace Heating," ought to come in this discussion.

MR. C. B. THOMPSON—Relative to galvanized pipe as against tin pipe, I

want to ask why tin pipe is supposed to be a better conductor for hot air than galvanized pipe?

MR. MILLER—Speaking of galvanized iron, it absorbs the heat more than tin pipe does. The reflectiveness and smoothness of tin pipe would conduct the hot air with greater velocity.

MR. JONES—The reason galvanized iron pipe is not as good a conductor for warm air as tin is because it is made of iron and galvanized with zinc and galvanizing is liable to peel off, and then the iron absorbs the heat, radiating it into the basement much more than does tin pipes, which deflect the warm air, causing a greater velocity than is the case with galvanized iron pipes.

MR. DAVIS—As I understand it, the less heat a pipe throws off the better.

MR. THOMPSON—If a hot air furnace were used at such a high temperature as to take the galvanizing off an ordinary galvanized pipe used for conveying warm air to the living rooms, I think it would be a dangerous apparatus for the house. There is no reflection of light inside a pipe, and I cannot see where that has anything to do with it. We know that the radiative power of zinc (which is the principal metal used for coating galvanized iron) is low, and the same is true of tin, there being little difference in this respect between the two metals. Personally, I object to galvanized iron for smoke pipe for the reason that, under excessive heat, the coating peels off, but I cannot see how that would be possible when used for conveying warm air.

MR. JONES—It is a well-established fact that where furnace dealers and heating engineers require the warm air pipes to be made of galvanized iron they do so because such pipes are so large that it would be impossible, practically, to get tin large enough to make these ducts. I think galvanized iron is used on large work on account of the large sizes of ducts required and the necessity of having something stiffer than tin.

MR. OLDACRE—I have used galvanized iron for furnace work and have had as good results as with tin. It is more durable. So far as the peeling of the galvanizing from the iron is concerned, I have never seen it occur, except where the furnace was too small and had to be forced to accomplish its work. Where that is the case, the same thing would happen to the tin pipe. The heat would be sufficient to turn it to another color so that you would not know whether it was tin or black iron.

MR. DAVIS—My opinion is that tin is used for conveying warm air to a greater extent owing to the fact that it is much cheaper.

PROF. HOFFMAN—The point was mentioned as to the loss of heat from the two metals. I cannot say now how much difference there would be, but assuming there was a difference, such pipes are supposed to be covered with some insulating material. Further, the transmission of heat from an ordinary pipe from a hot air furnace is often not a great factor, especially where the air around it is fairly warm. One reason why tin is used is that it is so much smoother on the inside. We all know that every possible advantage should be given for the transmission of the air, the motive force being so slight.

MR. CHEW—The statement has been made that there are no rules for furnace heating.

PROF. HOFFMAN—There are rules covering every point.

MR. W. W. MACON—I would like to ask Mr. Jones about air velocities in furnace pipes.

MR. JONES—My experience is that 100 ft. velocity per minute is all the velocity that can be obtained through a warm air furnace pipe with a pitch of 1 in. in 12 in., where the air supply is sufficient. I have never tested a horizontal pipe, but it would be my opinion that you can conduct air from the starting point as many feet as there are inches in the diameter of the pipe at a velocity of 100 ft. per minute.

TOPIC NO. 2

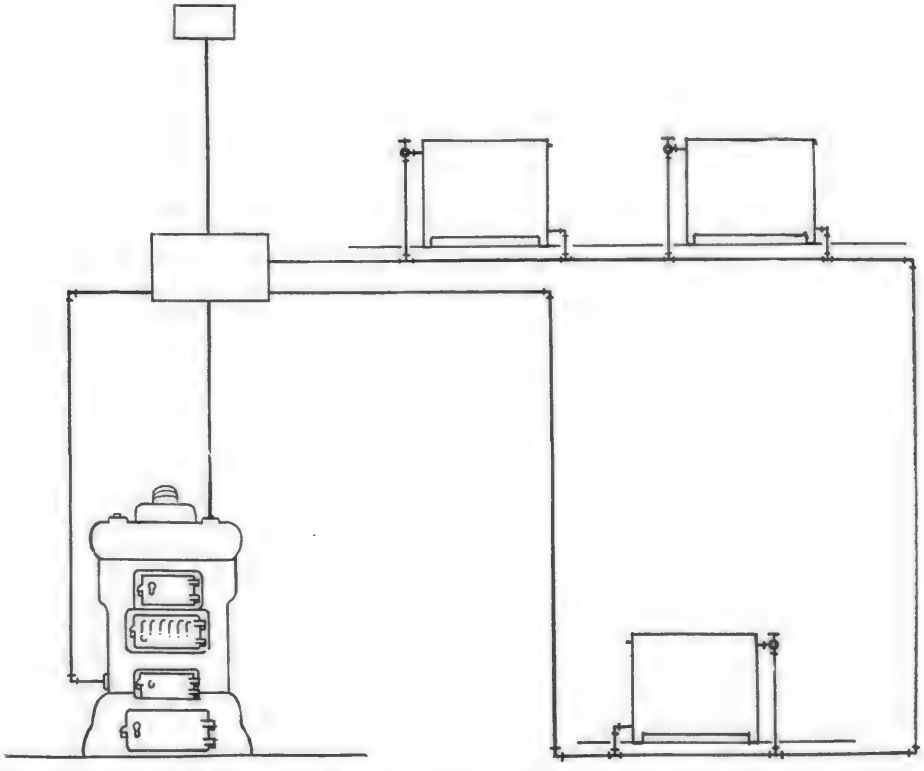
The Effect of Increased Pressure in Hot Water Heating Systems

DISCUSSION

MR. DONNELLY—I saw a hot water plant some time ago, a description of which would come under this topic.

The radiators were most of them located 100 to 150 ft. from the heater, and a 2 in. circuit main was used to supply them. This main was not very well graded, as it was said that this was not necessary with the system that was used, and in some places it dropped to the floor and rose again to supply a radiator as shown in the accompanying sketch. The size of the pipe and the amount of radiation used in this, as in other cases with this system of circulation, was such that the circulation desired would not be obtained until the water was heated to a very high temperature. On the day I saw it, the temperature was about 50° outside, and the temperature shown by a thermometer in the supply pipe was 230°. The temperature in the return after being re-heated by steam that was produced in the heater, was 130°. Therefore, the normal temperature of the return would be about 115°, thus giving 115° difference in temperature between the supply and return main.

The statement was made that this plant had a very rapid circulation, but I thought that the circulation was extremely slow, and I would like to have the opinion of some of our members upon it.



MR. DONNELLY'S DISCUSSION. RAPID CIRCULATION HOT WATER HEATING SYSTEM

Rapidity of circulation depends not only on the velocity of the water flowing through the pipe but upon the area of the pipe. Circulation to be effective is velocity multiplied by area and where this is produced by proper sizes of pipe, the difference in temperature between the flow and the return is always reasonable in amount, never exceeding 10° to 20°.

I, therefore, consider the system as

illustrated as having a very slow circulation and believe that the proper test for rapidity of circulation as well as efficiency of circulation is the difference in temperature between the flow and return. I think that the best results are produced when the difference is 20°, rather than 100° or more.

MR. CHEW—A man was talking to me once about hanging a weight on the safety valve of the expansion tank and thereby getting 15 or 20 or 40 lbs. pressure, so that when you heated the water to a higher temperature you did it without expenditure of fuel. His theory was that the return water would come back to the boiler at a higher temperature and would absorb the heat as readily as if it came back at a lower temperature.

SECRETARY MACKAY—My experience in connection with hot water heating is that anything that will increase the temperature of the water will increase the temperature of the escaping gases and rob the system of any claim made for it of economy. A low-pressure team apparatus would be more reliable than any hot water apparatus that had any means of increasing the temperature of the water. I have tried pressure systems of different kinds, including special systems to increase the pressure and I find I can get as good results with greater economy of fuel and less danger through apparatus not under pressure than with a weight on the expansion tank.

PROF. HOFFMAN—The higher the temperature of the water, the higher will be that of the gases, because the amount of flow depends on the temperature. If you increase the temperature of the water you must increase the temperature of the gases.

Afternoon Session—July 24

Simplifying the Installation and Operation of School Heating and Ventilating Apparatus

BY S. R. LEWIS

(*This paper was published in* THE HEATING AND VENTILATING MAGAZINE *for July, 1908.*)

DISCUSSION

MR. WEINSHANK—The statement is made in the first paragraph that "the plant shown in the accompanying plan and marked No. 1 may be described as standard." Does the author mean standard design? It has been my experience in blast work that in one case out of a hundred the designer will place the fan in a corner of a building, unless compelled to. It is usually located in the center of the building or centered at one side, but not at the end. If the author meant the design to be considered a model one, he contradicts himself later on when he states many objections to this design. The author also states that furnace heating in large buildings is subject to the same line of objection as that found with Plan No. 1.

PRESIDENT MACKAY—I think Mr. Lewis refers to the largest type of building in which the arrangement of boilers, fans, tempering coils, etc., would be arranged generally as shown on his plans.

MR. JOHN F. HALE—I think in one case Mr. Lewis takes the heated air independently and in the other he takes the cool air and passes it to the plenum chamber. That is the distinction between the two plans.

MR. JOHNSON—Furnace men generally install a heating system in the manner shown in Plan No. 1, while the steam fitters' practice is in accordance with Plan No. 2. You can install a furnace at one end of a building and convey the warm and cold air in ducts, locating the fan near the flue. Often, with such an installation, you can operate the furnace by gravity.

PRESIDENT MACKAY—Is that very efficient?

MR. JOHNSON—I have done such work for seven or eight years and got very satisfactory results.

PROF. HOFFMAN—What kind of furnaces?

MR. JOHNSON—Long furnaces with immense heating capacity and very heavy. These furnaces weighed

about 6,000 lbs. each. They were all in one battery near the center of the building.

PROF. HOFFMAN—Have you ever had any experience as to consumption of fuel with the hot air furnaces as against steam blast plants?

MR. JOHNSON—I found the fuel consumption was less than with the steam system. I am not an advocate of the furnace blast system. The only reason such a plant is installed is generally because the initial cost is less. For instance, where a steam blast system costs $6,500 or $7,000, a furnace blast system of the same capacity costs about $5,000.

MR. WEINSHANK—I full agree with Mr. Johnson in his statement that the reason the furnace is being used nowadays is because it is cheaper. In reference to what Mr. Lewis says that "it may well be that we will see that day when the direct-air heater shall supplant the steam boiler and coils," I will state that he hopes against hope, for the reason that we see every day that the furnace is becoming a thing of the past, just as the old reliable wood stove and fire-place. Now, why? It is cheaper to put in a stove and cheaper to put in a furnace or a fire-place than a steam plant. But we have learned by experience that a steam plant is cheaper in the end. I have had experience in competing for large schoolhouse work where we were bidding on a steam plant in connection with fans and coils. Bids were taken for the same buildings from the hot blast furnace men. Of course, the prices differed greatly. It was often a question whether the school had money enough to put in steam. If they had enough money they put in steam because they learned by experience that in a few years the difference in the cost of operation would pay for the difference in the cost of the two systems.

MR. KAUFFMAN—Furnace plants are put in on account of the cheapness of the apparatus, but I know where a number of these plants in the Middle West have been thrown out recently.

MR. DONNELLY—There ought to be no question about the comparative amount of fuel consumed by steam and hot air furnace systems for heating schools. It has been the subject of a good many tests and I do not think anyone can safely say that very many schools will select a hot air furnace if they can afford to pay for steam. I think we all know that where schools have been tested for heating and ventilation, the schools heated by steam have been found far superior to those heated by hot air furnaces.

The hot air furnace has its own field of usefulness, and there are some buildings in which it gives very good results. However, the problem of schoolhouse heating and ventilating is not easy to solve when the hot air furnace is used, and in my opinion it is very doubtful if they will ever be successful in this field.

MR. DAVIS—In Kansas City they are putting in steam blast systems exclusively in public school work.

MR. CHEW—Mr. Brady, of Kansas City, has expressed himself in the proceedings of the society as having had experience with furnace blast systems and getting good results from them. Whether the system is satisfactory for the large buildings he is now heating is another question.

MR. DONNELLY—While on the subject of economy of coal and hot water, about six or eight years ago, at Greenpoint, Long Island, I was asked to examine a 5-story building with a large library occupying one end of the first floor. The nine apartments had never been heated, but the library was heated by a hot air furnace. I was engaged to lay out a plan for warming the apartments. I asked how much coal they had been using in the hot air furnace and found the amount to be 25 tons a season. I gave them a figure on a heating system for the apartments. They wanted to know how much it would cost additional to put steam in the library, that is, a boiler

large enough to supply the library as well as the apartments. I gave them a price on that and I told them that 25 tons of coal would heat the library and all the apartments and this proved to be the case.

There is an example of enormous waste. It did not seem possible that they could get 25 tons of coal burned in that furnace and get the heat up the chimney. It did not get into the library.

PRESIDENT MACKAY — Maybe a badly-installed furnace plant and a most excellently-installed steam plant.

SECRETARY MACKAY—While I am not an exponent of the furnace system, I want to call attention to the fact that in Massachusetts, when the present ventilating law was adopted, the only school that fulfilled the requirements for ventilation was one in Charlestown, Mass., heated by a hot air furnace, and within the last four or five years a number of good-sized buildings in that State, placed under the supervision of the district police, have had furnace systems installed with fans and have given the desired results. I think it is wrong for us to decide against such a system when it is being used successfully in Massachusetts, as well as in New York State and in New Jersey. A furnace, if properly made and proportioned to the building, will heat as well but not as economically as steam or hot water.

I was called in a few years ago in connection with a building in New Jersey heated by indirect steam and later changed to direct. It was an 8-room school and it burned 95 tons of coal a year and had been doing so for five years. They were building twelve additional rooms of the same size, making twenty rooms in all, and they were in a quandary what to do, as they could not afford the additional amount of fuel that they thought would be required. They estimated that it would take about 300 tons a year if the proportion were maintained. The question of fuel guarantee came up when I designed the apparatus for the enlarged building. I could not by any method of figuring make the plant take over 75 or 80 tons of coal a season. They asked if I would guarantee 75 tons. I replied that I would guarantee 100 tons. They had been burning 95 tons to heat an 8-room building and that building is now being heated and ventilated according to the state laws of New Jersey, and has been for six years, with a consumption of fuel averaging 65 tons of coal a winter for the whole 20 rooms. So that steam plants can be placed to be wasteful as well as economical in fuel.

PROF. HOFFMAN—We have been comparing the efficiency of the furnace system with a direct radiation steam system. If you put in air for ventilation you must heat it and in exhausting the air many of these heat units are lost. In other words, we pay for our ventilating air. Don't compare a badly-constructed furnace with a good steam or hot water heater. The discussion should be as to the efficiencies of furnaces and heaters or boilers. I want to inquire of Mr. Donnelly if in his plant they had any provision for ventilation in connection with the steam system.

MR. DONNELLY—No, sir.

PROF. HOFFMAN—Did you have any return circulation of air in the library?

MR. DONNELLY—Yes, the stairway. The air went down the stairway to the furnace.

PROF. HOFFMAN—I believe that where a first-class apparatus is installed, whether furnace, steam or hot water, the system will give satisfaction so far as heating the building is concerned. It is the ventilation air that gives the excess expenditure of money.

MR. KAUFFMAN—Possibly one argument is that the pipes in a furnace system are exposed in places which causes a loss of heat during transmission over long distances.

SECRETARY MACKAY—The hot air men have tried to do too much with furnaces too small for the work. We are discussing a hammered down system.

Cast-Iron Heaters for Hot Blast Work

By Theodore Weinshank

(*This paper was published in* The Heating and Ventilating Magazine *for July, 1908.*)

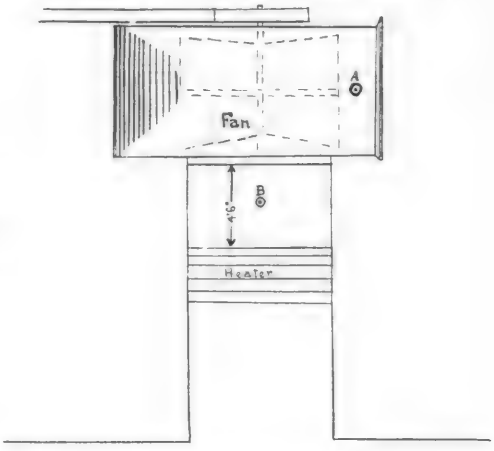
DISCUSSION

Mr. Davis—I would like to have Mr. Weinshank show us what the prominent points are on which he asks the opinion of the society.

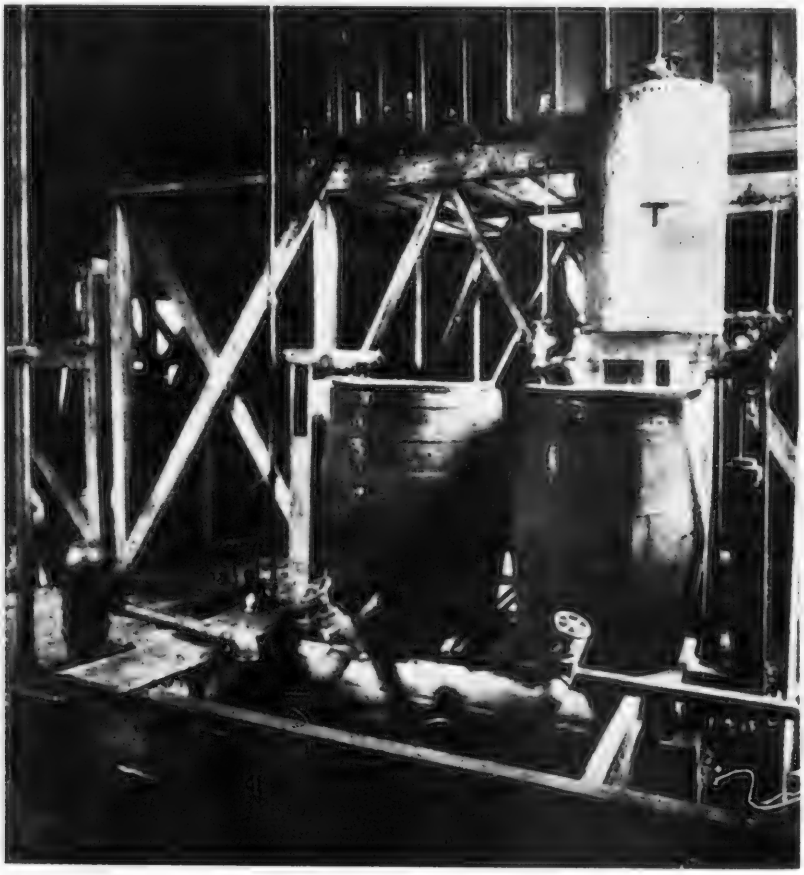
Mr. Kaufmann—Especially the approximate distance from the fan to the heater, etc.

Mr. Weinshank—Since the inside and outside temperature varied, we reduced this volume to an "equivalent volume at 70°. That is to say, air at 70° was taken as the standard and all tests were made upon this basis.

In reference to rise of temperature, as shown in table 3, I will state that a thermometer was suspended in the casing between the heater and the fan at b (Fig. 1). The temperature recorded at this point was greater than we expected. We interpreted this



MR. WEINSHANK'S DISCUSSION. FIG. 1



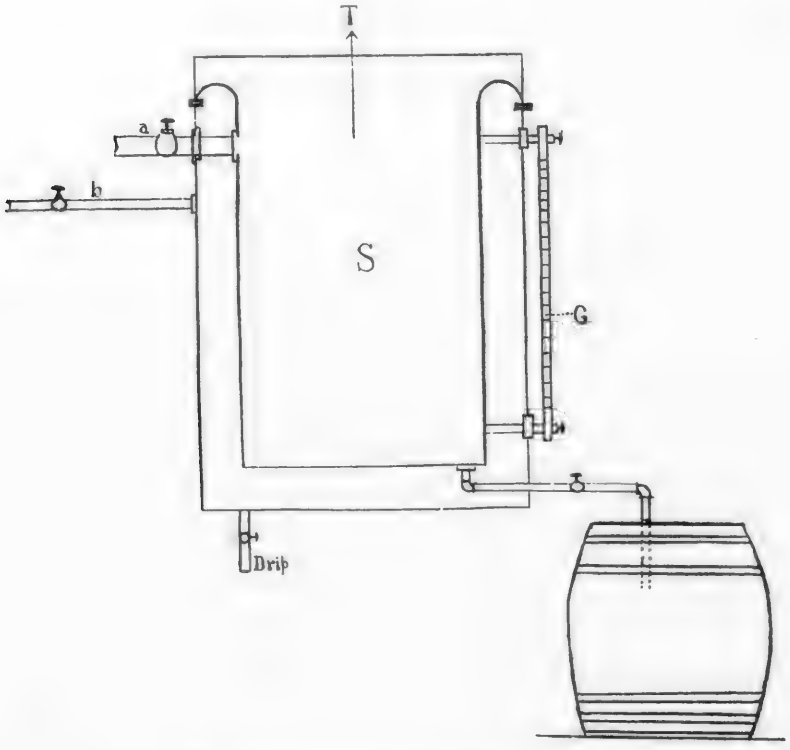
MR. WEINSHANK'S DISCUSSION. FIG. 2

high temperature being due to the radiation and velocity of the air. To overcome this another thermometer was suspended at (a) (Fig. 1) and the difference noted. The readings at (a) were considerably lower than at (b), which was probably due to losses by radiation from the fan or for some other reasons. In order to have this loss constant during the tests, we endeavored to retain a constant temperature in the room in which the tests were made.

To determine whether or not the air is passing over the heater uniformly, and whether or not the air is being heated uniformly over the entire surface of the heater, the thermometer at (b) was placed at different levels between the heater and the fan and no variation of temperature could be detected. This led us to believe that the distribution of the air throughout the entire surface was uniform.

PRESIDENT MACKAY — Have you any tests showing condensation?

MR. WEINSHANK — In this paper the writer intended to bring forth the efficiency of the heater from a standpoint of a temperature-rise and, therefore, the question of condensation has been omitted, but for your information I will state that the method of recording the amount of condensation was conducted as follows:



MR. WEINSHANK'S DISCUSSION. FIG. 3

Fig. 2 shows the general arrangement of the tank and weighing barrels. Fig. 3 shows a section through the tank. This apparatus consiste l of two tanks (T) and (S). Tank (S) was suspended inside of the tank (T), riveted solid to the outer wall of tank (T). The condensation from the heaters was connected to the inner tank (S) by means of pipe (a) properly valved. The tank (S) was also supplied with a calibrated glass gauge, (g). This gauge was

calibrated so that an inch of water in the tank meant so many pounds. In order to retain the temperature of the water of condensation, the outer tank (T) was provided with a pipe (b), properly valved and supplied with live steam from the boilers. Thus the water of condensation was of the same temperature as the steam. If the tank (S) filled up to a certain height, the valve (a) was closed and (c) opened and discharged into the barrel. As soon as the water was discharged (c) was closed and (a) opened again. The intention was to calculate the heat units transmitted per square foot of heating surface per hour per degree difference, as per Table 2, taking into consideration the latent heat only.

PROF. HOFFMAN—Was the thermometer at the outlet of the fan right at the opening or a little distance away from the opening?

MR. WEINSHANK—Inside the fan. The thermometer hung inside the fan casing at (a), Fig. 1.

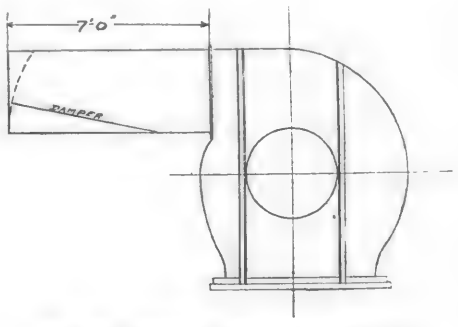
PROF. HOFFMAN—The idea just presented is rather new to me. Pressure is obtained by running a tube perpendicularly to the stream so that a current of air passing across the end of the tube will not affect the contained liquid from its velocity. As it stands now, one tube running with the current and one against the current, you are multiplying the pressure by a velocity constant.

MR. WEINSHANK — Prof. Kent, after examining the arrangement, thought it was the most reliable arrangement that could be used for determining static pressure.

PROF. HOFFMAN—It occurs to me that the Pitot tube opens against the stream with one leg and the other cuts square across and, consequently, we get velocity rather than static pressure.

MR. WILLIAM G. R. BRAEMER—I have always found that even if the distance between fan inlet and coils is large enough to place the thermometer outside of the influence of the direct radiation from the coils, a thermometer placed between fan inlet and heater coils indicates the temperature varying greatly in the different strata of air, the lower strata naturally being cooler, and in order to obtain the temperature fairly accurate the average of a series of readings in the different strata must be taken. Whenever possible I always place the thermometer in the air duct close to the fan outlet, as the air after passing through fan is well mixed and of a fairly uniform temperature. As Mr. Weinshank states, there undoubtedly is a very small drop in air temperature in passing through fan, due to loss through radiation, but this loss is so small in most cases that for practical purposes it may be neglected.

Mr. Weinshank states that in order to determine the air volume handled, the outlet of fan was boarded up until the opening through which the air was discharged was of the size desired, and anemometer readings taken. He also states that for certain sized openings the air velocity was found to vary greatly at different points. It would seem that by "boarding up" the fan outlet in the manner described, corners or pockets would be formed which would produce eddy currents that would make it difficult to obtain fairly accurate

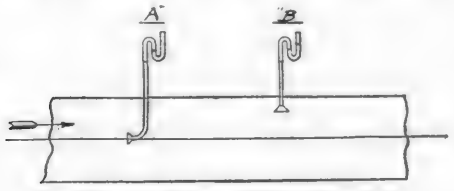


MR. BRAEMER'S DISCUSSION. FIG. 1

readings, either from the anemometer or the draft gauge. I have frequently, when testing fans on the testing block, used a sheet-iron extension to fan outlet about 7 ft. long arranged with a damper, as shown in Fig. 1.

By this arrangement I am able to obtain at once any desired propor-

tion between the discharge opening and the fan outlet, at the same time getting a fairly even flow of air through the opening, the velocity at the top being the greatest. In order to obtain the velocity accurately I have always found it necessary to divide the discharge opening into six or more squares by means of wires strung lengthwise and crosswise in



MR. BRAEMER'S DISCUSSION. FIG. 2

front, and taking the average of a series of readings from each square. As a general rule I have found the air velocity too high for application of an anemometer and have used a Pitot tube connected to a U tube draft gauge.

Referring to Fig. 2 and assuming the flow of the air in air duct to be in direction of the arrow, the reading of the draft gauge if Pitot tube is held in position a will indicate the total pressure, draft gauge if tube is arranged in position b will indicate the static pressure and the difference between the two readings will indicate the pressure corresponding to the air velocity which will enable us to calculate the volume of air passing.

MR. MACON—Was that disc designed there or was it designed elsewhere?

MR. WEINSHANK—We designed it there.

PRESIDENT MACKAY—How do you find the comparison of hot air as against steam pipe coil?

MR. WEINSHANK—Table 1 shows that there is very little difference as far as rise of temperature is concerned between the cast-iron heater and that of pipe coils. The only difference we found is that whereas in ordinary pipe blast coils it was impossible to get a uniform temperature in the space between the coils and the fan, we have been able to secure a uniform flow as well as a uniform temperature in the entire space between the fan and coils. The reasons for this difference we have ascribed to the construction of the heater, etc.

TOPIC NO. 4

Air Washers, Their Construction and Effect

(Mr. Sam. Kauffman, who spoke on this topic, illustrated the various types of spray heads now on the market. The substance of his remarks, together with his drawings, were published in THE HEATING AND VENTILATING MAGAZINE for April, 1908.)

TOPIC NO. 5

The Effect of Air Leakage Around Windows on Heating Apparatus

SECRETARY MACKAY—Unfortunately the paper received on this subject came in too late for the Publication Committee to embody it among the other papers. It gives results along the same lines described by the author, Mr. Whitten, at our last annual meeting. I understand it is Mr. Whitten's intention to give us further results of tests at the next annual meeting.

MR. WHITTEN—What the Secretary said is correct. The data given at the last meeting were figures obtained by experimenting with a blower on various sash to determine comparative leakage. What we have tried to do this time, and have partly accomplished, is to see just what heat losses were caused by these leakages. We built a box of about 80 cu. ft. capacity, with a window frame 2 ft. x 4 ft. in one side of it which was bolted on tightly. The first test was to measure the leakage through a hole placed opposite the window. The box was placed on the top of a high building where the wind had free scope. I will put on the board a few figures showing relative leakage with an ordinary sash and with one protected with metal weather strip. The apparent inconsistencies in the above table are due to shifting of wind, but the average differences seem to be maintained.

AIR LEAKAGE THROUGH ORDINARY AND WEATHER STRIPPED WINDOWS.

R. P. M. of 4-in. anemometers	R. P. M. of 2½-in. anemometer placed in opening in door of box	
Top of box	Weather-stripped sash	Ordinary sash
700	12	180
550	20	247
800	32	386
840	36	410
835	22	388

We put in this box an electric radiator of 800 watts capacity, plugged up the hole opposite the window and turned on the current. When the temperature of the interior reached 82° we shut off the current, removed the plug from the hole to allow the leakage of the window free access. When the temperature reached 70°, the current was again turned on and the plug still left out, allowing natural leakage free circulation. The sash was then changed for one having a metal weather strip applied and the same process gone through. A great many tests were made along these lines, two of which are illustrated herewith by curves.

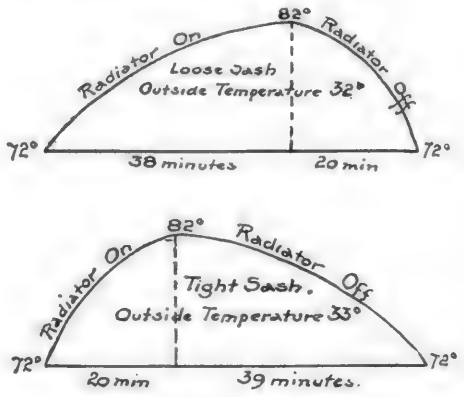
In another case with weather-stripped windows the temperature ran from 72° to 80° in eighteen minutes and back to 72° in forty minutes. A great many tests have been taken along these lines but these are samples. I intend to make some more tests in December when it is possible to get lower temperatures.

One thing I did in connection with the box was to place a tight shutter on the window and observe how long it took to heat the interior and to lose the same. Then I took the shutter off and with a practically tight sash repeated the process. On account of the small difference between inside and outside temperature it was not possible to get a definite line on the actual glass loss. The results were indicative, however, and showed that glass loss in still air is much smaller than usually given credit for. It was never possible to get a line on the actual glass loss.

MR. C. B. THOMPSON—Did the losses closely conform to what are known as the German co-efficients of heat losses?

MR. WHITTEN—Yes, they did; that is, with the Austrian co-efficients.

MR. C. B. THOMPSON—What is known as the German co-efficient of heat losses for buildings is used and



Wind vel. 3.75 to 4 miles per hour.

MR. WHITTEN'S DISCUSSION. CHARTS SHOWING COMPARATIVE AIR LEAKAGE BETWEEN ORDINARY WINDOW SASH AND WEATHER-STRIPPED SASH

accepted as standard all over the Continent of Europe. Péclet, the French physicist, did more laboratory work along these lines than anyone else, but Prof. Rietschel has taken Péclet's co-efficients and tried them out on a larger scale. The German co-efficient for glass has nothing whatever to do with the way the sash is fitted to the frame and, when you come to think of it, it would be impossible to give a co-efficient for the glass and the leakage about the sash, because one sash might be ¼ in. one would be tightly fitted, as you away from the frame, while the next describe.

If this society can get together sufficient data to establish a set of standards for the guidance of heating engineers, architects, and owners, it will have accomplished a great work. With an accepted set of standards, a heating engineer who installed work in accordance with such standards

could collect his pay and not wait, as he now has to, until cold weather to test the apparatus before he can get a final settlement. In Germany all that is asked of the heating engineer is to install the heating apparatus according to Rietschel's formulæ. Then, if the heating apparatus does not heat, the builder is called upon to make good. The German engineers, however, do not take the German co-efficient literally, but each man adapts them to his own particular practice.

MR. WHITTEN—The United States Government, in some cases, has reduced its radiation on information I have given its engineers on this matter.

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Morning Session—July 25

PRESIDENT MACKAY—There is one topic left over from last evening, No. 6. We will pass that for the present. We have a letter here from one of our members which relates to charges for engineering work. He says: "Is there any formal agreement or understanding between our Heating Engineers' Society and the American Institute of Architects? Kindly send me full information relative to it and a copy of the agreement if possible. A question has arisen as to charges and as to who owns the tracings prepared by an engineer for a client, an architect. What is the New York practice where an architect calls in a professional engineer to prepare a heating and ventilating design for him? Who owns all the work of the engineer, and do his plans and specifications stay in his, the engineer's, possession or in the architect's?"

On page 47 of the charter, one of our objects is stated to be, "to establish a uniform scale of prices for all professional services." So that is one of the subjects that is well within our province to discuss.

SECRETARY MACKAY—I replied to this letter stating my personal opinion to be that when I prepared plans and specifications for an architect, he paying me for them, they were his property, but when the owner employed me and I worked in conjunction with the architect, the plans and specifications were mine. I told him, however, that I would get the views of the other members.

PROF. HOFFMAN—If nothing is said about ownership before the architect employs the engineer, it seems reasonable that the architect should own the tracings. I believe, however, that such originals may be held by the engineer in deposit, with free access to them by the architect.

PRESIDENT MACKAY—It would be well if some established practice were decided upon.

MR. BERRY—It seems to me it would be a good thing if the society has not already done so, to establish some basis for arriving at a charge, possibly a percentage similar to the architects' charges. I was called in on a matter before the court recently in regard to chimney flues. In this case the contractor had taken the work and agreed to give certain results. We stated what the custom was and the matter was immediately settled. To give a statement as your own opinion has little weight, but to state that it is the custom of a trade or profession gives a basis to work on.

SECRETARY MACKAY—In the early history of the society we had a committee called the "Special Committee to Arrange with the American Institute of Architects in the Matter of Professional Charges." It was composed of Stewart A. Jellett, chairman; Prof. R. C. Carpenter and Henry Adams. This committee worked with a committee appointed by the American Institute of Architects. In the architects' scale of charges to-day there is a clause stating that "where it becomes necessary to employ a heating and ventilating engineer or any other engineer to assist the architect in his labors, he is to be paid by the owner of the building in addition to the architect's fee."

Speaking of the matter of flues, referred to by a previous speaker, sometimes the responsibility depends upon the form of contract. If a

man agrees to heat a building to a certain temperature, it is assumed that he has specified that the owner is to supply a flue of sufficient size and good draft. I know a case where the contractor agreed to heat a building, saying nothing of the existing flues. After having completed the work, he found he had insufficient draft and endeavored to have the owner enlarge the flue. But because he had virtually accepted the flue in making the contract he was compelled to enlarge it at his own expense.

MR. DONNELLY—I think it is well established that architects' plans made for one building may not be used for another building unless the architect is paid over again. I do not see why the architect who employs a heating and ventilating engineer to make plans and specifications for the heating and ventilation should be allowed to retain those plans and use them for a second building without giving the heating engineer additional compensation.

PRESIDENT MACKAY—That would be done if the ethics of the profession were rigidly adhered to.

MR. CRYER—I do not see why the heating engineer should give the architect his original plans.

MR. BERRY—In the case I spoke about regarding the matter of flues, the flue was not specifically mentioned. They had simply a verbal understanding that the chimney was all right. My understanding is that the uniform practice of the Furnace Manufacturers' Association is that the owner shall supply the flue and if it is not satisfactory, he shall promptly supply suitable draft. I refer to the Association in Canada, one in New York and the one in Pennsylvania.

PRESIDENT MACKAY—That would depend on the contract. The contract could include a clause stating that "the owner is to furnish a chimney of good and sufficient draft." If that clause is not there and the contractor guarantees to heat the building and it develops the chimney is not sufficient, it looks to me as though the contractor were responsible.

SECRETARY MACKAY—I think the ownership of plans is largely a matter of agreement between the engineer and the architect. Any plans the architect owns bear the stamp, "Property of So and So, Architect," and are to be returned to him on the completion of the building and not to be used for other purposes unless by agreement.

(For the benefit of those who are not familiar with the work done by the Society's Committee on Professional Charges, we present herewith a review of the reports presented by this committee, including the resolution finally adopted by the American Institute of Architects.)

The Establishment of Definite Fees for Professional Services of Heating and Ventilating Engineers

As far back as January, 1899, the matter of fixing definite fees for professional services of heating and ventilating engineers was taken up by the American Society of Heating and Ventilating Engineers. At the annual meeting of the society, in January of that year, Mr. Stewart A. Jellett was named a committee of one to consider and, if possible, to formulate a system and schedule of charges by heating and ventilating engineers for services in preparing plans and specifications and in superintending construction of such work.

At the semi-annual meeting of the society, at Saratoga, in July of the same year, Mr. Jellett presented a preliminary report in which he suggested a schedule of charges as a basis for discussion and asked that the society consider the whole matter and refer it to a new committee.

Acting upon the suggestion, the committee was increased by the addition of two members, the new committee being made up of Stewart A Jellett, chairman; Prof. R. C. Carpenter and Henry Adams.

Following the semi-annual meeting, the chairman, Mr. Jellett, corresponded with the American Institute of Architects with a view to securing the coöperation of that body in establishing a schedule of charges. The matter was formally brought before the American Institute of Architects at its annual convention held in Pittsburg, November 13-16, 1899. There it received favorable consideration and on January 10, 1900, a committee of architects was appointed by the President of that body to meet a committee from the heating engineers' society.

The second report of the heating engineers' committee states that the matter of the adjustment of professional fees was taken up with the committee appointed by the American Institute of Architects, and, as a result of their deliberations, the following resolution was submitted by the architects' committee at the annual meeting of their Institute at Washington, in December, 1900:

PROPOSED RESOLUTION FIXING PROFESSIONAL CHARGES

"We recommend that the schedule of charges of the Institute be so amended that the minimum charge for professional services in connection with electrical, mechanical and sanitary engineering, heating and ventilating, shall be 10% on the cost of these portions of the work, the architect to select or approve any experts required and to assume all expense for their services, whether rendered by members of his professional staff or engaged for a specific work."

This resolution was based on the following considerations as stated by the architects' committee:

1. In the design, construction and equipment of modern buildings the problems of sanitary, electrical and mechanical engineering, of heating and ventilation, of structural work and foundations are much more complicated and their solution much more expensive than was the case when the present schedule of charges of the Institute was first adopted, at which time, to use words taken from a recent convention report, "the erection of a building could safely be left to a competent carpenter's foreman, or to a master mason." And this development has, in many cases, rendered necessary the employment of experts, either permanently on the staff of the architect, or by engagement for a specific work.

2. The amount of labor and expense required from an architect now, even when the best of experts are engaged, and independent of their fee, is greater than was contemplated when the present schedule was adopted, but is necessary for the moulding of these parts into complete harmony with the architect's design, in all classes of work.

3. The usual charge for efficient expert service is 5% of the cost of the special work involved where this amounts to $10,000 or more, with a gradual increasing of the percentage as the amount diminishes from $10,000 down to $2,000.

4. The expense of expert service should be paid by the client as a necessary part of the cost of the work.

5. The architect should select the engineer or expert, whose work should be subordinate to that of the architect, and should be under his direction, in hearty coöperation with him.

6. The architect should assume all expense for expert services necessary for the proper execution of a work, and the schedule fee for heating and ventilation, sanitary, electrical and mechanical work should be 10% on the cost of these parts.

This resolution above quoted did not meet with unanimous favor on the part of the Institute and the whole matter was referred to the directors of that body with power to amend the schedule at their discretion.

Here the matter rested until November, 1901, at which time the American Institute of Architects meet in Buffalo, N. Y. At that convention an amendment to the schedule was reported, not in the words of the report recommended by the committee, but as follows:

RESOLUTION AS ADOPTED BY AMERICAN INSTITUTE OF ARCHITECTS

"Expert services—Where heating, ventilating, mechanical, electrical or sanitary problems in a building are of such a complicated nature as to require the assistance of an engineer, the owner is to pay for such assistance as the architect may require. Chemical and mechanical tests, when required, are to be paid for by the owner."

This clause appears in the schedule of "minimum charges," published by the American Institute of Architects, as amended at the Buffalo convention, November 4, 1901.

In commenting upon the final form in which the resolution was adopted by the American Institute of Architects, Mr. Jellett said, at the time:

"It is a decided step forward, in that the Institute recognizes that it is necessary to employ experts, that it is necessary that they shall be paid, and to find out who shall pay them. I believe that it is a matter which if followed up, after this entering wedge has been successfully used, will develop into a definite and tangible agreement. The committee has accomplished partially what it started out to do. The opposition came from some of the largest architects in the country, from a number in New York City, Boston and Chicago particularly, whose business was of such magnitude as to warrant their having engineers continuously in their employ. They claimed that it interfered with their business to a certain extent; that it put other architects, not having business of the same magnitude, in the same position, and forced them to ask for additional fee for additional service.

"You notice the wording of the first resolution, 'whether employed by architects or for specific work.' These architects succeeded in defeating the adoption of the complete resolution on the basis that they had men in their employ, but they made it a point that the client having such men, their services were worth more money."

No further action has been taken up to the present time, either by the American Society of Heating and Ventilating Engineers or by the American Institute of Architects.

TOPIC NO. 6

The Proportion of Radiator Surface and the Method of Ventilating Rooms for Drying Macaroni

MR. HALE—Two weeks ago I had a talk with the president of the Association of Macaroni and Spaghetti Manufacturers who asked the question whether there was any rule whereby a room could be designed for the proper drying of macaroni. He said he had been in the business a number of years and he had never found a satisfactory method. In the south they dry entirely by placing the macaroni in the open air. They must have ventilation and they must avoid drafts. The problem is to keep it warm and not dry it too rapidly.

MR. WEINSHANK—I never dried macaroni but if the amount of moisture in the raw product is a fixed quantity, then a very good method can be applied so that the drying would be continuous. A product similar to macaroni, namely, curd, is being dried in the West by a continuous method very successfully. The only difference between the curd and the macaroni is that the curd was dried to such a state that it was ready for the grinder, whereas I understand macaroni must retain a certain amount of moisture. This, however, should not change the condition, and some continuous method could be devised.

It is my opinion that if the amount of moisture in the raw product and the amount of moisture in the finished product is a fixed quantity, then the number of cubic feet of air re-

quired to dry that material, also the amount of heat required, is very easily determined.

SECRETARY MACKAY—Macaroni has to remain stationary. It seems to me any movement of it would not accomplish the purpose as it would cause the macaroni to break.

MR. HALE—The gentlemen told me that they had attempted to dry macaroni with the fan blast system but it was impossible to get results. The problem is to dry macaroni in a day instead of in six days.

MR. KAUFFMAN—I know of a macaroni manufacturer in St. Louis who has a building 60 ft. by 200 ft. On the second floor of the building the drying is done in spaces of about 8 ft. from the windows on each side. He has a rack made of two layers of ⅞ in. matched stuff, and he pushes the rack from one room to another and keeps it in each a certain number of hours and so on until it is properly dried. It takes about two days to complete the process.

MR. DONNELLY—Seven or eight years ago I took a contract to heat a macaroni factory. It was an 8-story building of fairly good size. The problem is not in the drying of the macaroni but in the curing of it. Unless it is cured and dried very carefully the outside is dried first and if it is, it becomes full of tiny cracks, breaks into small pieces, and is then useless. I would not recommend treatment with air washers. If you get too much humidity the macaroni gets pasty on the outside. At present this concern is drying macaroni by having direct radiation on the side walls, not under the windows. They put the macaroni in and shut the room up tight; then they gradually let in air through the windows. It takes an Italian who can speak three languages to ventilate these rooms properly.

About five years ago, some one offered to construct a room in which macaroni could be cured and dried for these same people, and guarantee results. A fan was used with some hot blast radiation, but the problem was not solved satisfactorily and the apparatus was afterwards torn out. The proprietor informed me that in some parts of the room the macaroni would dry on the outside and crack, while in other parts of the room, where the circulation was evidently insufficient, it would remain wet and become mouldy.

MR. WEINSHANK—From what I have heard I do not see much difference between curing or drying macaroni and drying glue. I have been successful in drying glue, which is a very delicate material and if not treated properly will be ruined. I do not see why macaroni can not be cured in the manner described by Mr. Kauffman, on racks and passing through various stages of temperatures.

MR. DONNELLY—If the Committee on Fan Blast Data wants some original data on drying glue, there is a plant on Long Island City, erected 40 or 50 years ago, where they are drying glue and using a wooden fan, wooden blades and arms, 20 or 22 ft. in diameter. It is one of the oldest fan installations in the country.

Factory Ventilation

DISCUSSION OF MR. CLAYTON W. OLD'S LETTER

MR. WEINSHANK—About ten years ago Miss Jane Addams, of Chicago, went before the legislature of Illinois and obtained the passage of a bill to the effect that every factory should provide proper ventilation, that every emery wheel should be provided with a proper hood. Not having information she came to the office where I was and asked for the assistance of an engineer to write the specifications. I was sent to Miss Addams, at that time of Hull House, Chicago. We got up the specifications in proper form and after the law was passed, she saw that it was enforced. Inside of a year every factory in Chicago was equipped with proper hoods, proper fans, etc., and I will say that to-day the factories in Illinois are in better condition in that respect than those in any other state in the Union. There is a fine for

non-compliance with the law and also a reward is offered to anyone who will prosecute and convict the owner of a factory building which is not equipped according to law. It seems to me it is the duty of this society not only to go on record in favor of these laws but to aid the factory inspectors in enforcing them and in prosecuting offenders.

Air Cooling

By Theodore Weinshank

This paper was published in The Heating and Ventilating Magazine *for August,* 1908.

DISCUSSION

Mr. Weinshank—This paper was written with the intention of bringing out the theoretical cost of cooling the air for ventilating purposes, but the most important reason for bringing this paper before the society is to uphold the movement started sometime ago toward the investigation of what is considered proper humidity for ventilating purposes. In the winter time, where a building is heated with hot blast with the outside temperature at zero the relative humidity of the air becomes very low as the air has been heated say to 150° without any moisture being added to the air.

The air washer manufacturers have provided means by which a certain amount of moisture can be added to this air, so that the relative humidity of 50% is retained constantly. The expense of supplying the air with moisture has been proven to be very small and nearly all manufacturers are now furnishing their air washers with the so-called humidifiers.

In the summer time if a fan is used for ventilating purposes and an air washer is used in connection with same, too much moisture is then being added to the air, and the result is that the air becomes humid.

It is to overcome this difficulty that the writer has brought forth in this paper facts showing the cost of condensing this moisture.

Mr. Whitten—Speaking of putting air in a room and maintaining the proper relative humidity throughout the building, a very prominent engineer had that question up within a year and found it difficult to maintain the relative humidity and desired temperature of the air because he could not control the openings in the building. He had the largest installation where he wanted the building free from dust. He went further and sealed his windows absolutely so that they were immovable. In order to still further protect these large interior rooms he had a separate exhaust on the entrance coils in order that he could prevent any intake of outside air or dust into the room by causing a very slight outward draft.

Mr. Donnelly—I want to ask whether any plants have been installed along the lines described by Mr. Weinshank and whether they have been found to be practical?

Mr. Weinshank—This paper is strictly a theoretical deduction. I do not know of any plants installed along these lines.

Mr. Donnelly—I asked Mr. Weinshank if he had installed any plant for cooling air, because I know that such plants have been installed, and it would materially add to the value of our proceedings if we had a description of the construction of such a plant and the results obtained from its use. In fact, I believe that the basis of all papers read before this association should be the description of plants installed and results produced, rather than discussions along theoretical lines. The theoretical discussion could then be more profitably carried on, using the plant described and the results obtained, as a basis for these discussions.

I also want to ask Mr. Weinshank if it is not a fact that in order to get air with 50% of relative humidity, you have to cool the air down below the desired final temperature. Also if you have saturated air at 50° or 40° do you not have to reheat it to get the relative humidity down to 50%?

In other words, Mr. Weinshank assumes that it is possible to remove the humidity or moisture from the air by passing it over refrigerating coils, without cooling the air. I do not think he is correct in this assumption.

MR. WEINSHANK—This paper, as stated before, is to show the theoretical cost of removing the moisture from the air and the cooling of same.

From the results obtained you will notice that where it required to reduce from the air 7 B. T. U. to remove the humidity, only 2 B. T. U. was required to cool the air after the moisture has already been removed. The removal of the moisture, or the humidity from the air, is of far greater importance than the cooling of the air. While one can not be accomplished without the other, the figures thus shown explain the cause of the suffering in the summer time during a sultry spell.

Some years ago I attempted to remove the moisture from the air by circulating cold water at 55° through the hot blast sections. The cost of the water was not considered and, therefore, we wasted same to the sewer. I found that a considerable amount of moisture was deposited on the pipes, and the temperature somewhat reduced but not sufficient to show satisfactory results.

A letter was read from Prof. Kent, chairman of the Committee on Standards, asking for suggestions in connection with subjects to be taken up by the committee.

DISCUSSION

MR. HALE—At one of the meetings of the Illinois chapter the question was brought up as to the possibility of establishing a standard for outside temperatures, that is, the standard that specifications should call for in certain localities. Quite often the contractors will figure on a plant and will put in their specifications to heat the building to a certain temperature in zero weather. Another man figures on the same job and he specifies he will do it at a certain point below zero. The result is, it is difficult for the architect to determine which is the better proposition.

The question has come up as to whether it would not be wise for the Committee on Standards to make inquiry as to the temperatures generally figured on in different parts of the country and have it arranged so that if certain members of this society are figuring on a plant in the South, in New Orleans or in Texas, they will all have the same outside temperatures to figure on, instead of one man having zero and another man 20° above. The same thing would apply to St. Paul and that section, where one man would figure on 15° below zero, outside temperature, and another man on 40° below zero.

I suggest that this matter be considered now and referred to the Committee on Standards.

SECRETARY MACKAY—It seems to me that the Committee on Standards could get valuable data from the Weather Bureau as to average temperatures and extremes, which would be more authentic than you could get in any locality.

MR. HALE—It is true you can get from the Weather Bureau a record of extreme temperatures. In Chicago we have had it 20° to 25° below zero, but that does not mean we figure our radiation on that basis. However, I know there are contractors and engineers who figure zero, 10° below, or 15° below. If we were all figuring on the same job and each one figured on different outside temperatures, our estimates would be affected. The question is, what standards should be adopted for different localities?

MR. DONNELLY—2° below zero is the coldest we get in New York, as a rule, and we usually write specifications guaranteeing to heat the building to 70° in the coldest weather. THE HEATING AND VENTILATING MAGAZINE publishes temperature records in various American cities, and I think they will prove to be a valuable record.

MR. WHITTEN—The records referred to in THE HEATING AND VENTILATING MAGAZINE also contain the wind velocities. There seems to be a wide divergence in this respect among heating engineers. One will figure on 10° above zero with a 40-mile wind, and another on 15° above zero with a 15-mile wind. It seems to me the conditions in each locality should be taken into consideration.

Coefficient of Transmission in Cast-Iron Radiation

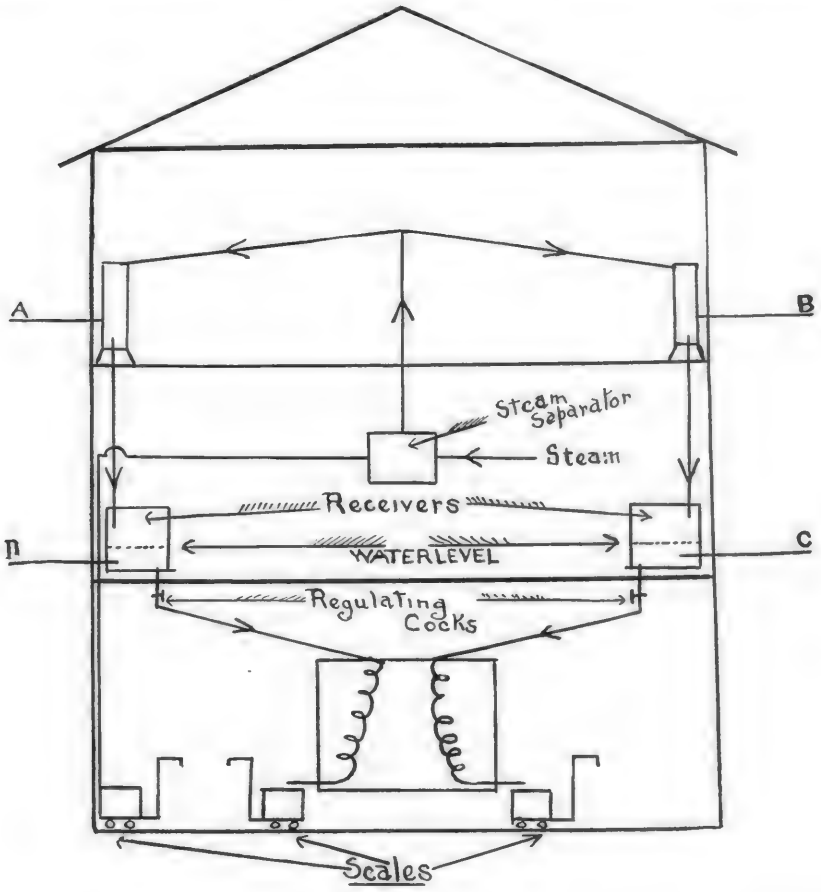
BY JOHN R. ALLEN

This paper was published in THE HEATING AND VENTILATING MAGAZINE *for August,* 1908.

The following topic was also offered, to be discussed in connection with Prof. Allen's paper: "Theoretically, steam under 20 in. of vacuum has three times the volume of the same steam under pressure equal to the atmosphere. Query: "Will it fill three times the space; if not, why not?"

DISCUSSION

PROF. HOFFMAN—The sketch on the board is taken largely from photographs and illustrates the test described in this paper. I take it, A is the radiator referred to as the standard. This is of the two-column type. B is the radiator under test. Both are cast-iron radiators. The steam pipes, of course, are drained by a steam separator. This condensation is caught and weighed. The condensations from the radiators fall to reservoirs C and D. These, of



PROF. HOFFMAN'S SKETCH—ARRANGEMENT OF TESTING APPARATUS DESCRIBED IN PROF. ALLEN'S PAPER

course, are kept partially filled with water by means of valves which control the outlets; the water passing off through sets of coils to the weighing scales.

In opening the discussion, I would call your attention to a few points. The author states "The steam pressure was varied from 70 pounds gage per square inch to atmospheric pressure and the room temperature from 117° to 51° F. The number of tests made was seventy-six. During all of the tests, the humidity of the air was noted."

It will be seen that when the difference in temperature between the steam and the room air was less, the two-column radiator shows up better, and when the difference is greater, the three column radiator shows up better. Also, by use of the formula (page 22) you can easily get the relation between the steam temperature and pressure as compared with the room temperature on any given day for a summer test.

MR. DONNELLY—In regard to the radiator test described, I wish to speak upon one phase of the subject which I think is also applicable to the topic for discussion.

In all records of radiators tests that I have seen, there has apparently been no attempt made to ascertain the amount of air that is left in the radiator while the test is in progress.

Steam radiators are never entirely filled with steam. There is always some air present, mechanically mixed with the steam, and I think it quite possible that all our radiator tests are incorrect and unreliable because no attempt has been made to find out how much air is present under test conditions and under usual conditions of operation.

Radiators, I think, are invariably tested with both steam and return connections and the general custom is to allow the return connection to blow freely and thoroughly so that all the air possible may be removed.

It is, therefore, incorrect to consider that radiators circulated upon a one-pipe system may be rated according to this test. Consider the last section of a one-pipe radiator with the air valve in the usual location, and I do not think that any one will assume that we get better than a 50% air removal from this section and this percentage of air removal would probably vary if the radiator was single, 2, 3 or a 4 column type.

The tests upon these radiators were made with steam pressures varying from atmosphere to 70 lbs. and the coefficient of heat transmission given per degrees difference in temperature, is based on results obtained with steam at these various pressures.

Now, if we assume that when the radiator was heated and the return blown out at a comparatively low pressure that the air removal was 90% and when the return was shut off, the absolute pressure inside the radiator was doubled, raising it to 15 or 16 lbs. gage pressure, the air would be compressed to about one-half its former bulk, and the radiator would then have practically a 95% air removal. If the absolute pressure inside the radiator was again doubled giving about 45 lbs. gage pressure we would have 97½% air removal. From this we can readily see that the coefficient of transmission as deduced from these tests may be very much affected by the percentage of air removal.

In the topic under discussion, the opposite effect is produced by a lowering of the pressure and this is probably the cause of the trouble. A 90% air removal would become only a 70% one when the pressure was dropped to 20 in. of vacuum and the air increased in bulk to three times its former volume. If, as may be the case, the percentage of air removal from the entire plant under discussion was only 80% at atmospheric pressure, leaving 20% of air in the radiators and piping, this air would increase to 60% at 20 in. of vacuum and would no doubt gather in one portion of the apparatus and produce the result described by Prof. Hoffman.

There is one other thing which may also contribute to this same end,

and that is the mechanical mixture of air and steam is probably very much better at higher pressures and temperatures than it is at lower ones. Thus, with a perfect mechanical mixture of air and steam, the air would be distributed in the steam throughout the entire apparatus, but, as the pressure and temperature are reduced, the mixture would become less uniform until the air and steam would disassociate and the air would collect in the apparatus in a separate body.

At one of the meetings in Chicago, I suggested that tests upon radiators with different known percentages of air removal, may be made by using a hot water type of radiator; filling the radiator with water to the desired point, then admitting the steam under practically atmospheric pressure, to the top and afterward drawing the water down to the test line in the return pipe without blowing out any of the air. I am still in hopes that some member of the society or the Committee on Tests will use this or some other method and furnish us with some information relative to the results produced by varying the percentage of air removal.

It may be found that, for the average conditions and pressures, the question of air removal is not an important factor and that we now obtain a very high percentage of air removal with the methods which we use, but if some one would try this test along these lines we would have some information upon a subject about which we know practically nothing at the present time.

If the radiator was vented of air in the usual way and then inverted, the steam supply shut off, and water turned in, it would be easy to ascertain the amount of air left in the radiator by having a gage glass upon it and noting how much air was left after the radiator was filled with water.

MR. G. D. HOFFMAN—I have in mind a house where, one day, the circulation would be all right in the front and the next day in the back. I could not account theoretically for that shifting of the heat from one end of the house to the other. If there had been a leak through the valves of the radiators you would naturally always have the same loss. One day the temperature would be perfect in the back of the house and another day it would be perfect in the front of the house. The whole system would circulate perfectly under a higher measure of vacuum. The minute we cut the vacuum down the front or back of the house would begin to cool and whichever got the start it would cool all through that part of the house.

Theoretically speaking, if the radiator is filled with steam under vacuum, the vapor which is three times the volume fills the space. Now, when there is a sudden condensation of that steam and without any accurate gage to determine whether that vacuum has picked up any more, the theory is when the steam which was evidenced by the heat of the radiator is gone we have lost the volume in the radiator and the vapor filling that space is gone. We have apparently created a greater vacuum there which ought to have a pull and pull more vapor in the radiator. Yet in this case, it did not have any effect upon it at all. Whichever got cool first would keep on cooling. My recollection is that there was a 3-in. main run off and connected with the side wall and a 2½-in. circuit in the back of the house and a 2-in. circuit in the front, both taken off that large main.

PROF. HOFFMAN—I think one reason for the cooling was the reduced pressure of the steam. By reducing the pressure, the heat units per cubic foot become less because of the increased volume of steam. Now, if the main pipes were too small to allow the volume of the steam to pass, some part of the system must suffer. The cold side of the house becomes the better condenser, thus robbing the rest of the house. It then becomes a matter for consideration which part of the house is the condenser. Whichever side of the house happened to get the most cold

wind would probably be the condenser for that day, and if enough steam could not get through the pipes to carry steam to all parts, that side would be the coldest for that day.

MR. DONNELLY—I cannot agree with Professor Hoffman. A year ago last January, I read a paper in New York which gave the comparative friction with varying pressures of steam. In an accompanying table, it was shown that as pressures somewhat above or below atmosphere are used, the change in the density of steam and resulting friction was very nearly offset by the changing rate of condensation, due to the change in temperature. The comparatively slight difference that does exist, favors the practice of an increase of radiation as the pressure is reduced, rather than the opposite as is usually maintained.

In regard to one side of the house or the other being cool, I believe this is a case of disassociation of air and steam. In a mixture of air and steam when the temperature is brought down they separate. If they do, the air must fall to the bottom and it tends to gather in one pocket.

MR. G. D. HOFFMAN—The theory is then, that the air being heavier than steam would create a greater vacuum in the radiator.

MR. DONNELLY—The air would tend to go to the bottom. I think all the air would go to one end of the house and all the steam to the other. When disassociated there would be pockets of air and pockets of steam. The circulation of the steam would tend to bring the pockets of air together, and there would be an accumulation until all the air got into one big pocket.

MR. DAVIS—If Prof. Allen's charts are correct, they will enable the steam fitter to make tests of a plant with any outside temperature.

MR. BLACKMORE—This is a very interesting paper and must be to anyone who has had anything to do with the construction of heating plants. Since Prof. Kinealy formulated a similar rule some years ago I have felt that the trade ought to take up the idea a great deal more than it has, for I feel the time has come when the heating engineers or those installing heating plants should adopt something of this kind in their specifications instead of using the ordinary form. I believe the table of Prof. Allen's is near enough for all practicable purposes. Wind velocities are a serious factor and I believe a move should be made in that direction so as to familiarize the public with the fact that there is an equivalent temperature at which to test heating plants. This society cannot adopt the table but I think it would be a long step in advance if the contractor would adopt that in his specifications.

PROF. HOFFMAN—I believe Prof. Allen's results were taken from experiments and are somewhat higher than those previously given in the society. We want to feel sure the results of these tests are correct, then if this rate of transmission is considered satisfactory, I think this table might well be adopted.

MR. BERRY—If we could get the manufacturers or the men who are erecting the plants to generally adopt this idea that it is possible to test the plants in other than zero weather, that it is the custom and had the endorsement of the recognized authorities in the heating profession that that is the correct thing to do, it would be a great aid to all men erecting such work.

There are a few concerns so old and well-established that they can say to the purchaser, "When this work is done you pay for it, otherwise we don't care to do your business." But there are a great many who cannot do this.

MR. C. B. THOMPSON—I have made a few experiments to determine the difference in temperature of a given room provided with a given radiator which was supplied with steam at constant pressure, with the outside temperature varying from zero to 85° above zero. By keeping steam on the radiator all night in the winter time, the air in the room could be maintained at a temperature between 68° and 70°, with the outside

temperature at or about zero. The summer tests were made at a time when the outside temperature varied from 70° to 85° F. A peculiar thing in regard to the tests made in warm weather is the length of time required to raise the temperature.

With an outside temperature varying from 82° to 85°, it required eight hours to raise the air of the room to a temperature of 105° (that is, the temperature was rising slowly during all that time), and in all the tests made we have never been able to get any such high temperatures as are shown in this table.

We have not gone far enough with these tests, however, to secure data on which any exact rules may be formulated.

MR. BLACKMORE—I would not advise taking tests with the outside temperature over 40°. I remember when the matter was brought up a few years ago we decided that an outside temperature of 40° was as high as we should go for making a test and securing satisfactory results. I have made experiments in the summer time and never was able to reach the temperatures mentioned here. If we limit ourselves to 40°, that is a temperature we can always find. We want to get the people accustomed to the idea that there is an equivalent.

PRESIDENT MACKAY—Did I understand you to say, Mr. Thompson, that with an outside temperature of 70° to 85°, you ran the apparatus eight hours and obtained an interior temperature of only 105°?

MR. THOMPSON—Yes, sir.

PRESIDENT MACKAY—That is a surprise to me.

SPECIAL TOPICS

How many members figure upon floor surface as a cooling medium in factories or mills with the ground exposed?

What tests, if any, have been made of the transmission of heat through modern concrete constructions, especially roof construction of varying thicknesses?

DISCUSSION

PRESIDENT MACKAY—I know of some heating contractors who have had a very sad experience because of not having data on the subject of transmission of heat through concrete walls.

PROF. HOFFMAN—Speaking to the first part of the topic, I should say it depended upon whether there was a movement of air under the floors.

(Topics 7, 8, 9 and 10 were grouped and discussed as one topic. Mr. Lillibridge had a written discussion which it was decided should be referred to the publication committee before being read.)

This completed the programme and the meeting thereupon adjourned.

*Purification of Air by Means of Ozone**

BY DR. G. ERLWEIN

The fact that ozone is an efficient destroyer of odors of every kind is now generally recognized, and ozone is already employed extensively for purifying the air of rooms. The question whether ozone, as it is used for this purpose, exerts a germicidal, as well as a deodorizing and oxidizing action, cannot be answered until special bacteriological researches have been made. It seems fair to assume, however, that ozone, which possesses so remarkable sterilizing properties when concentrated, is not wholly powerless to destroy atmospheric germs even when it is used in so diluted a form as is customary in ventilating apparatus, provided that the air is somewhat moist and is exposed for a long time to the influence of the ozone.

Within the past year the firm of Siemens & Halske of Berlin has put on the market a number of devices for purifying air by means of ozone,

*From the Scientific American.

some of which were shown in operation at the fourteenth international hygienic congress at Berlin. Some of the devices are described below.

The apparatus illustrated in Figs. 1 and 2 is designed for use in connection with large central ventilating systems. Both types of apparatus have air compressors and the ozone is generated by electrical discharges in cylinders of glass and aluminium.

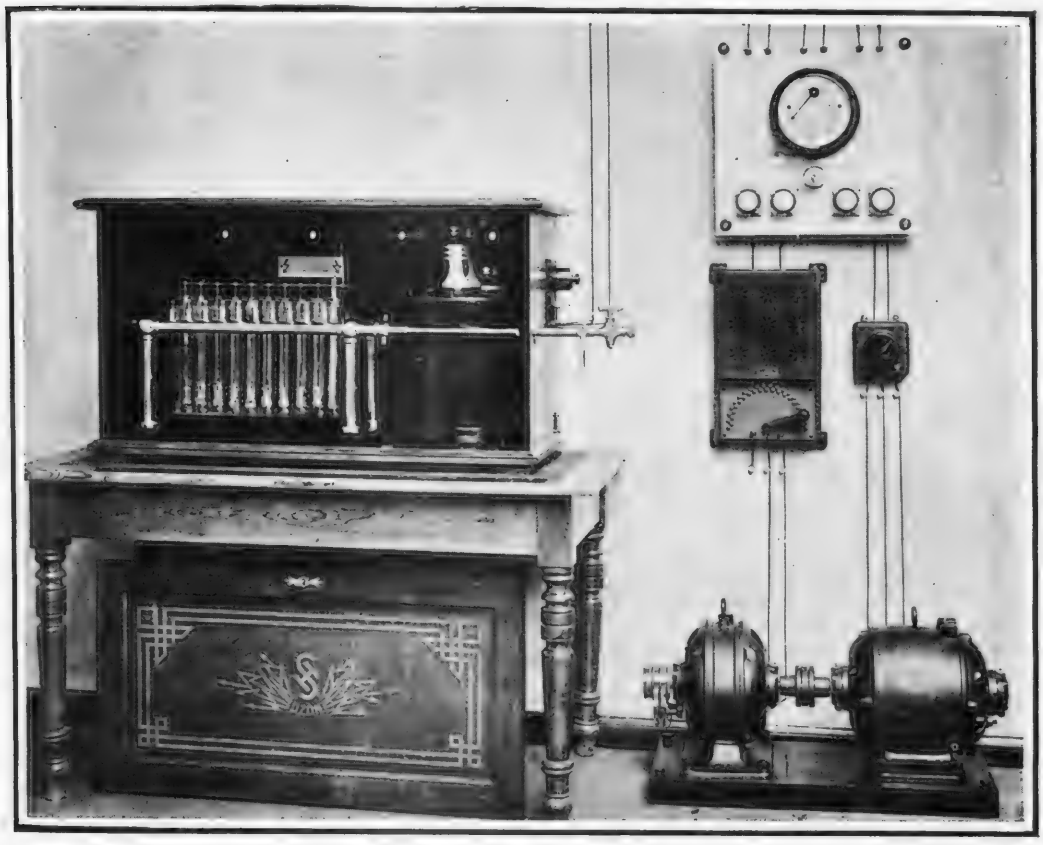


FIG. 1.—SIEMENS OZONIZING APPARATUS WITH TEN GLASS GENERATING CELLS AND ROTARY CONVERTER FOR CENTRAL VENTILATING SYSTEM

The apparatus shown in Fig. 1 has ten glass cylinders, while that shown in Fig. 2 has eight cylinders of aluminium surrounded by larger cylinders of glass. Both forms are operated by an alternating current, obtained from a direct current with the aid of a rotary converter, as illustrated, or taken from an alternating current circuit. One pole of the ozone generator is grounded and the wire which connects the other pole with the transformer is insulated and made inaccessible, so that the apparatus may be handled without danger at all times. These ozone generators have high efficiency, as shown by the curves of Fig. 3. As in other electric generators of ozone, the quantity of ozone formed is a function of the current density and the quantity of air which is forced through the apparatus. The consumption of energy is small, being only 0.75 kilowatt in the small model (Fig. 1) and 2 kilowatts in the large model (Fig. 2). As only a very small proportion of ozone is required for the purification of air—from 0.05 to 0.5 milligramme (0.008 to 0.08 grain) of ozone to a cubic meter (35.3 cu. ft.), according to recent experiments—this apparatus is capable of ozonizing 200,000

cubic meters (about 7,060,000 cu. ft.) of air per hour.

In cases where it is desired to ozonize only a portion of the air current, used for the ventilation of certain rooms, it is advisable and quite practicable to insert the ozone generators in the branch air pipes. A simple apparatus for this purpose is illustrated in Figs. 4 and 5. It consists of a number of air-cooled ozone generating cells with plate electrodes, and a "step up" transformer. The entire apparatus is mounted on a frame in the air pipe, with the concavities of the inner electrodes facing the current.

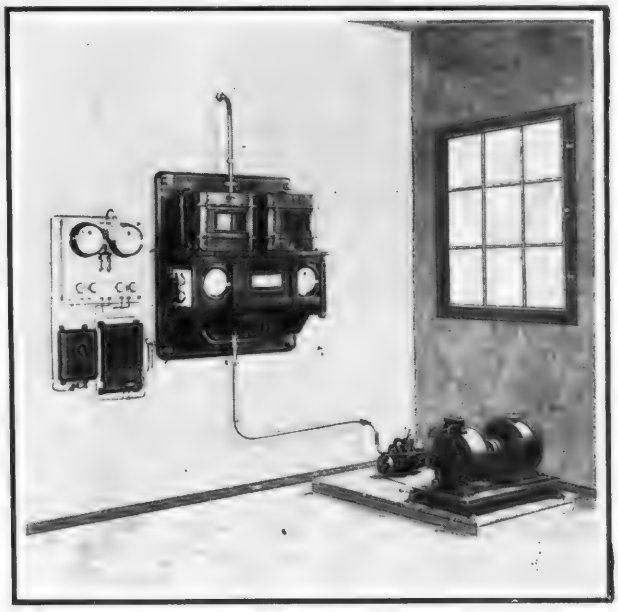


FIG. 2.—OZONE APPARATUS FOR CENTRAL VENTILATION

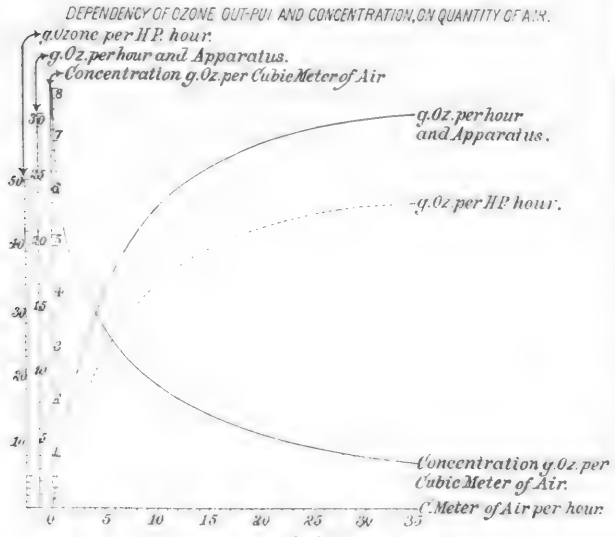


FIG. 3

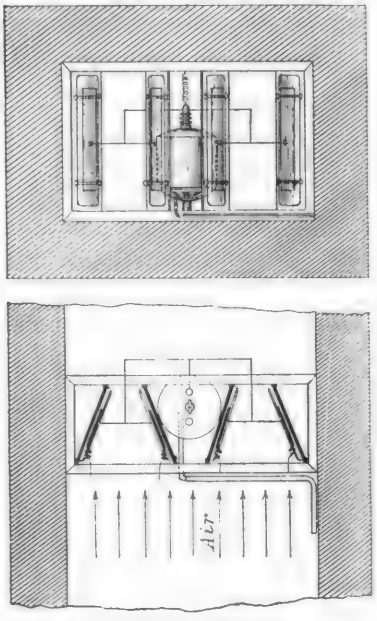


FIG. 4.—OZONE ELEMENT AND TRANSFORMER IN BRANCH VENTILATING PIPE

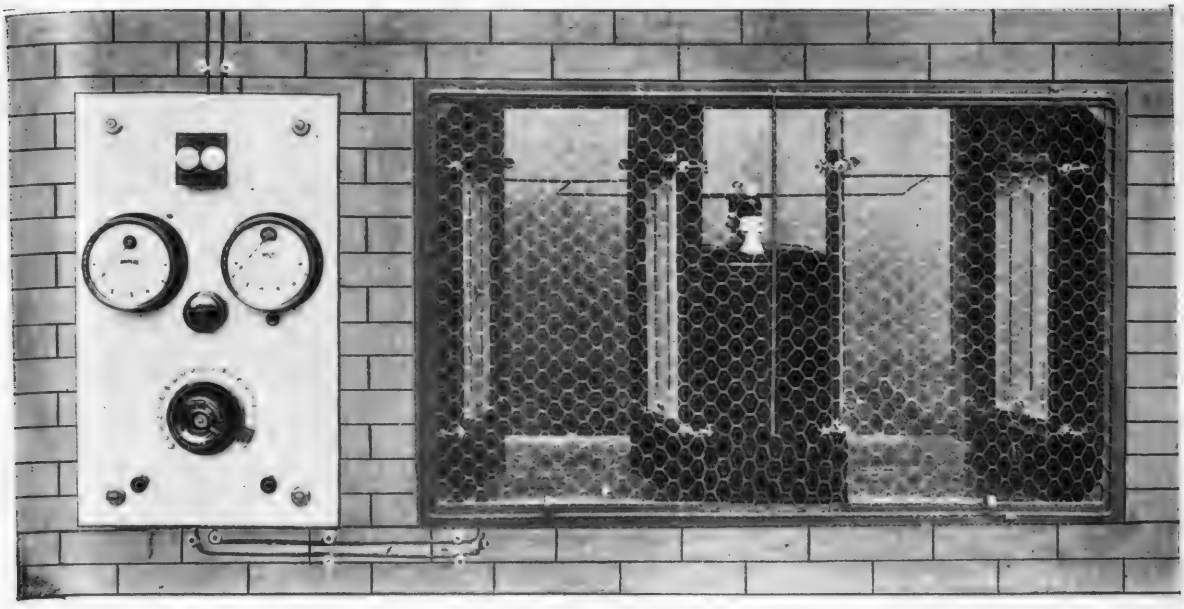


FIG. 5.—OZONE APPARATUS IN BRANCH VENTILATING PIPE

Fig. 6 illustrates other types of electrodes of ozone elements. Fig. 7 shows the appearance of the completed apparatus, type *d*.

The number of ozone elements required is determined by the volume of air and its degree of impurity. The normal types of Siemens ozonizers are made for currents of from 2,000 to 8,000 cubic meters (71,000 to 282,000 cu. ft.) of air per minute and require a power of from 100 to 400 watts. The cost of operation is therefore very small.

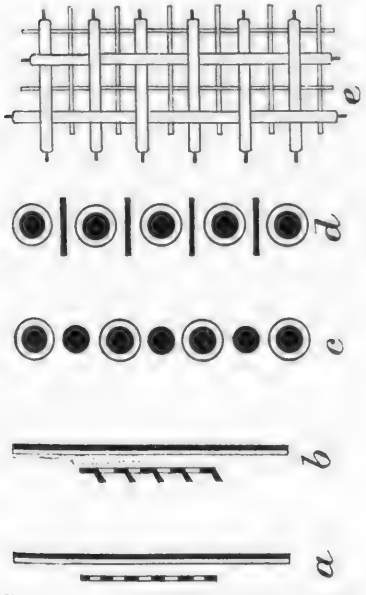


FIG. 6.—VARIOUS TYPES OF ELECTRODES OF OZONE ELEMENTS

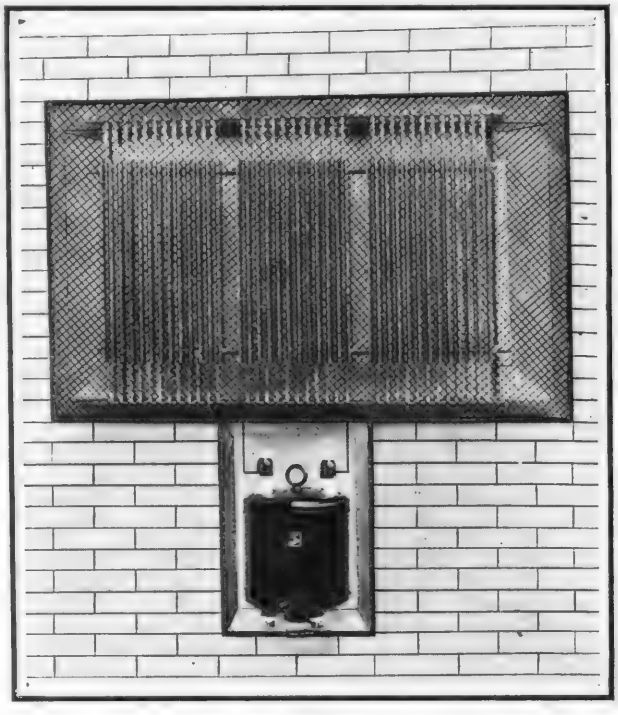


FIG. 7.—OZONE APPARATUS WITH ROD AND PLATE ELECTRODES IN THE SHAFT

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PURIFICATION of air by means of water sprays, or air washing, as it is commonly called, is passing through a period of development that has all the interesting features that attended other important developments in the art of ventilation. Since the introduction, on a commercial scale, of the air washer for use in business buildings the subject has received probably more attention on the part of heating engineers than any other one item connected with their business. The wonder is now that the matter was so long neglected, for today a heating and ventilating system, certainly one in a public building, is considered incomplete without some effective method of eliminating the dust and supplying the proper amount of humidity to the air.

Considering the time and money spent in the evolution of the air washer and the theory upon which the practical requirements have been worked out, it is somewhat startling to find the subject approached, with apparent success, from an entirely different direction. Making use of the purifying qualities of ozone an apparatus has been introduced in Germany for the production of this element by means of electrical current. According to the description of the apparatus, published on another page of this issue, its small size makes it convenient for use either in a room or in an air duct where, it is claimed, the ozone generated will probably nullify, if not destroy, the injurious particles in vitiated air, as well as revivifying such air. This, of course, has no bearing on the matter of dust removal which would remain to be taken care of by some other means.

THE theory of such a device for purifying the air will recall to many the remarks of one of the speakers at a recent meeting of the heating engineers' society, a man who has given much time and thought to the study of air purifying. He had made the remark that where an air washer was used the air could be recirculated to some extent without any harmful effects upon the occupants of the building. "First of all," he said, "we know that the slight increase in carbon dioxide is not deleterious; the change or increase from 6 parts of carbon dioxide in 10,000 parts of air to 10 or 20 parts is not deleterious, but we use that only as a measure to determine how vitiated the air is. The things that are really deleterious are the epithelium scales that come from the throat as we breathe and the organic matter carried with the moisture. If we wash that out of the air, substituting for this moisture other moisture, we purify and revivify it, but we do not take out the carbon dioxide."

A FINE sentiment, that may be taken to heart by trade association members generally, was uttered by Secretary W. H. Barnard, of the Master Sheet Metal Workers' Association, when he said in the course of his report:

"As you go back to your homes from this convention I do not wish you to feel that your responsibility is ended and that you have nothing to do—your work has just begun; this is not the wind-up of the past year; please get this in your mind; it is the beginning of another busy year, and if the National Association is to grow, if it is to be a power in the land, if it is to do good to the master sheet metal workers in your community, much depends upon your individual and efficient efforts. As you attend the regular meetings of your association and give it the benefit of the sunshine of your vigor and efforts, it will prosper; the reflection of your work will be easily seen in the reports that will come from you six months hence."

IT will be of interest to our readers to know that the stenographic report of the proceedings of the heating engineers' recent meeting in Niagara Falls, which is concluded in this issue, has been carefully revised, in all important details, by the various speakers, so that the remarks attributed to each speaker may be taken as authoritative.

NOW that the scheme adopted for the ventilation of New York's Subway has had a year's trial, it is admitted to be ineffective, an outcome predicted in these columns at the time. The present system, as will be recalled from the published description, consists of a number of openings between stations, leading from the tunnel to the street surface, through which air is forced by passing trains. Louvers swinging outward prevent a return movement of air through the openings. The partial vacuum thus created in the tunnel is depended upon to draw in a supply of fresh air at the station entrances. For the greater part of its length the Subway is four-tracked, with no intervening partitions, and in actual operation, the ventilators have taken care of only a fraction of the air that was expected to pass through them, the remainder being driven in whirling eddies to the other side of the tunnel.

This effect of the movement of the trains is so well established that the engineering department of the road has come out in a formal report declaring that the remedy for the present ineffectiveness of the ventilating system lies in the building of continuous partitions between the tracks, thus making a tube of each track. This can hardly fail to prove effective and the scheme seems all the more plausible when it is stated that the additional expenditure required would not exceed $58,000. One of the curious features of the case is that such an improvement will be reckoned in the cost of the subway and the city will pay the bill.

COMMENCING with the next issue, a special department in THE HEATING AND VENTILATING MAGAZINE will be devoted to an index of current heating and ventilating literature appearing in the columns of our contemporaries. Arrangements have been made whereby copies of each journal listed may be obtained directly through our office on receipt of the stated price.

Identification of Power House Piping by Colors

By William H. Bryan

(Concluded)

No. 5. Waterside Station, No. 2. New York Edison Company. Supplied by Mr. J. P. Sparrow, member A. S. M. E., chief engineer.

No. 6. Scheme used in paper mills. Furnished by Mr. E. S. Farwell, member A. S. M. E.

No. 8. Scheme prepared by the writer for the Hamburger Department Store, Los Angeles, Cal.

No. 9. Scheme used by European heating engineers on plans. No information is available as to whether this plan or any others are used in the plants themselves.

No. 5 WATERSIDE STATION No. 2, NEW YORK EDISON COMPANY, NEW YORK

Pipe lines	Colors of pipe	Colors of bands, couplings, flanges, valves, or fittings
Steam to turbines, boiler cross-overs, U-bends, leaders and ring header	Black	Brass
All other steam lines	Buff	Black
Steam, exhaust	Buff	Green
Steam drip lines including drip receivers, discharges to boilers, blow-downs, reducer lines and manifolds, but not risers	Orange	Black
Gravity drip discharge from manifold to receiver, from receiver to header, header to boilers and blow-downs and reducer lines	Orange	Permanent vermilion
Blow-offs, drips from water columns, and all low pressure drips, roof leaders, over-board discharges from hot well pumps	Lead	Black
All Croton water from meters to inlet nozzles for feed water heaters, water jackets, oil coolers, step bearing pumps, or to any point where water changes temperature, or mixes with other water	Dark blue	Permanent vermilion
Warm Croton, from jackets and cooling coils to feed water heaters, also hot well to pumps and f. w. heaters	Dark blue	Black
Feed water from heaters and pumps to boilers	Pompeiian red	Same
Fire lines, ash hopper service, priming lines, and all other service using water from fire pumps	Permanent vermilion	Same
Cylinder oil throughout station, from barrel tanks to cylinders	Tan	Permanent vermilion
Bearing oil from overhead tanks to all bearings, small service, and can filling valves	Tan	Black
Bearing oil from all bearings and catch-alls to filter tanks, and from filters to pumps and over-head tanks	Tan	Light green
Pneumatic system	Black	Same

No. 6 SCHEME OF E. S. FARWELL FOR PAPER MILLS

Steam lines	White	Same
Cold water	Black	Same
Sprinkler lines	Red	Same

No. 7 U. S. INTERNAL REVENUE DEPARTMENT: FOR DISTILLERIES

Mash or beer	Red	Same
Low wines, back into still or doubler	Blue	Same
Spirits from still to cistern	Black	Same
Water	White	Same

No. 8 HAMBURGER DEPARTMENT STORE, LOS ANGELES, CAL.

Pipe lines	Colors of pipe	Colors of bands, couplings, flanges, valves or fittings
Steam, High and medium pressure	White	Same
Low-pressure heating lines	Aluminum bronze	Same
Exhaust lines	Gray	Same
Water, pure, drains from high-pressure and exhaust head drips	Pink	Same
Impure drips, overflows and boiler blow-offs, to blow-off tank	Black	Same
From city mains or deep well, and general house distribution	Light blue	Same
Iced drinking water lines	Dark or navy blue	Same
Returns from heating system	Aluminum bronze	Same
Boiler feed	Bright red	Same
House supply (hot)	Maroon	Same
Sprinkler lines including tank, excess pressure, and draining system	Blue	Same
Oil, lubricating system	Light brown	Same
Boiler supply, fuel	Dark brown	Same
Air, vacuum heating and house cleaning lines	Light green	Same
compressed	Dark green	Same
Refrigerating, ammonia, gas	Yellow	Same
Ammonia, liquid	Bronze	Same
Brine	Orange	Same

No. 9 EUROPEAN HEATING ENGINEERS

Steam, high pressure	Carmine	Same
Steam, low-pressure	Orange	Same
Steam radiators	Blue edge filled with green	Same
Direct-indirect radiators	Blue edge filled with yellow	Same
Return steam	Dark green	Same
Overflow	Brown	Same
Cold water supply	Violet	Same
Hot water flow	Sienna	Same
Hot water return	Blue	Same
Hot water radiators	Blue edge filled with blue	Same
All iron parts, such as boilers, doors, stairs, engines, blowers, dampers, chains, registers, heating pipes, traps, expansion tanks, etc	Blue lines	Same
Fresh cold air	Light green	Same
Fresh warmed air (warm air chambers)	Carmine	Same
Mixed air (warm and cold)	Yellow	Same
Vitiated air (ventilating flues)	Blue	Same
Circulating or reheated air	Violet	Same
Air vent pipes	Blue	Same

Correspondence conducted by the writer with leading power plant engineers throughout the country indicated the practically unanimous opinion:

That a uniform system would be of decided advantage.

That it should, if possible, be made standard, so as to be universally acknowledged and adopted.

That the time was ripe to enlist the good offices of this society toward the bringing about of uniform practice.

There can be no question as to the value and convenience of such a system. To the extent that similar ideas have already been adopted they have proved of decided advantage. The operating force is better able to

operate and maintain the plant. Action is quicker, mistakes fewer, and repair bills less. When a particular color, or combination of colors, in a pipe system always means the same thing, in all plants, and under all conditions, substantial progress will have been made. To change engineers will then mean no disorganization of the force, no interruption of the service, hardly a drop in its efficiency. When such a color scheme has once been thoroughly learned, possibilities of er ror are largely at an end unless a new scheme must be learnd with very new plant. Important as it is for the attendants, it is even more so to visiting or supervising engineers, or inspectors, making their regular rounds, whether for governmental or insurance purposes.

It would seem desirable for such a general scheme to meet the following conditions:

It should be suitable for power houses of all kinds and sizes, electric, water, isolated, manufacturing, refrigerating, etc.

It should follow existing systems as far as can be done consistenly, so as to reduce confusion.

It should use the colors which have already come to be associated in our minds with the various classes of service, such for instance as white for steam, blue for water, red for fire protection, brown for oil, etc.

It should be as simple as possible.

The colors should be of such a character as not to fade under working conditions. They should withstand the effects of heat, water and ordinary use and abuse. Established trade names should be used.

Incidentally there should be some attention to harmony of color, and to the practicability and ease of reproduction in printed charts.

The system should, if possible, be one which could be used on drawings to be filed away for future reference.

The means of identification are many and easy. Not only are there the primary colors, but there are two or more shades of each. Furthermore, almost endess variety may be secured by giving the bands, couplings, flanges, valves, and fittings a different color from the pipe. It would seem desirable to distinguish between supply and delivery pipes as is done in the Navy. This could easily be accomplished by using a light shade of the pipe color for the former, and a darker one for the latter. At least two coats of paint should be applied, on the surface of the finished covering, or on the bare pipe when uncovered—this, of course, after the constructing and testing are complete. Arrows showing the direction of flow should be stenciled on the pipe at frequent intervals. Also in very complicated systems, a brief scheme of lettering indicating the pipe's purpose.

Such a system, to be reasonably complete, should cover the following kinds of service:

STEAM

High pressure (100 lb. and over) saturated.
High pressure (100 lb. and over) superheated.
Medium pressure (under 100) saturated.
Medium pressure (under 100) superheated.
(Each of the above might be furthe: subdivided as between main and auxiliary engines.)
Low pressure (about atmospheric pressure), for heating, drying, etc.
Exhaust, main, to condenser.
Exhaust, main, to atmosphere.
Exhaust auxiliary to condenser.
Exhaust auxiliary to atmosphere.

DRAINS, DRIPS, ETC.

From saturated steam lines to trap or Holly receiver.
From superheated steam lines to trap or Holly receiver.
From trap or Holly receiver to boilers.
Low pressure or gravity.
Fom trap to heater or hot well.
Blow-offs from boilers, heaters, etc., to blow-off tank.
Over flows from heaters, hot wells, blow-off tanks, etc.
From crank pits.
House and roof drains.

WATER—COLD

Supply, city or other external.
Supply, well, cistern, river, lake or other alternate.
Supply, salt.
(Above from inlet, meter or other source to point where temperature

changes, or where it mixes with other water, to primary and secondary heaters. jacket pumps, etc.)
Cooled from cooling towers.
Hydraulic supply, under pressure, for elevators or other power service.
Discharge from same.
Cooling, to engine bearings.
Iced, for drinking throughout building.
Domestic, to lavatories, sinks, etc.
Fire or sprinkler lines, including tanks, filling and drain pipes.
Flood pipes for magazine or trimming tanks.
Salt water discharge.

WATER—HOT

From hot wells and heaters to economizers and boilers.
Returns from bearings to hot well and heater.
Circulating water, condenser to air pump.
Circulating water, pump to cooling tower.
Air pump discharge to hot well.
Overboard discharge from hot well pump.
Domestic, to lavatories, sinks, etc.
Flow, for house heating system.
Return, from house heating system.
Return from steam heating system.

OIL

Cylinder, to high pressure cylinders.
Cylinder, to low pressure cylinders.
Cylinder, to auxiliaries.
Engine, to bearings.
Engine, from bearings.
Crank case.
Fuel, to boilers.

AIR

Compressed for pneumatic tools, cleaning, pumping water, dry lines of sprinkler system, etc.
Low pressure, for pneumatic tube, cash or parcel systems, etc.
Vacuum for dust cleaning, air removal from radiators of heating systems, etc.
Ventilation, fresh cold.
Ventilation, fresh warm.
Ventilation, mixed.
Ventilation, vitiated.
Ventilation, recirculated.

GAS

Artificial, for illumination.
Artificial, for power.
Natural.

REFRIGERATION

Ammonia, liquid.
Ammonia, gas.
Brine.

The writer had intended to work out a new and tentative scheme along these lines, for consideration with this paper. However, he concluded that to do so at this time would simply add to the existing confusion.

The Relative Efficiency and Durability of Cast-Iron and Pressed Steel Radiators

By Ray D. Lillibridge

Notwithstanding the obvious advantages of sheet-metal radiation in the way of reduced weight, reduced space occupied, facility of handling and ability to withstand without breakage or injury the freezing of contained water, there prevails in some quarters the general impression that this new form of radiation also possesses inherent defects which render it unworthy of consideration as a substitute for cast-iron radiation.

The durability and efficiency of the new form of radiation have been assailed particularly. Dire predictions have been made as to the short life of the thin steel walls of the pressed radiation as compared to the thick walls of the cast-iron type. Ominous comparisons have been issued, of which perhaps the one most often heard is that likening the pressed radiator to the steel kitchen boiler, which has proved to be comparatively short lived. Finally, on the subject of efficiency, ignoring the more than compensating virtue of a thin metal wall versus a thick one, capital has been made out of the theory that steel has a slightly lower radiating power than iron.

WEAKNESSES IN SCREW NIPPLES

If we are going to discuss the vulnerability of steel to the corrosive impurities of water in radiating systems, one has but to refer to the steel nipples connecting the sections of the cast-iron radiators, which are located in the direct path of all circulation, to call to attention that on this score the cast-iron chain is no stronger at the point of its weakest link than steel. The screw nipple used between sections of cast-iron radiators is of much smaller cross section, especially after threading, than the 20-gauge (16-gauge after galvanizing) steel radiator. As for push nipples, these as regards durability are about on a par with the walls of pressed radiators, except that the many that have come under the writer's observation were either not galvanized at all or the galvanizing was decidedly scant. Or, why not refer to the steel pipe connections which are similarly weakened by threading, but which are as integral a part of the radiator system as the radiators themselves? In both the screw nipples and pipe connections not only is the material pared down, but the galvanizing, if any, is removed by the threading; so that these elements are far more liable to be eaten away than is the continuous, well-galvanized sheet metal of the pressed radiator.

Consider further the small ¼-inch pipe commonly used with vacuum systems and compare the thinness of the wall of this ¼-inch pipe, especially after cutting

the threads, with the thickness of the pressed-radiator wall. Moreover it is seldom that these pipes have any interior protective coating. Think of the trouble that would arise with vacuum systems if these little pipes should fail from corrosion. As this consideration seems to arouse no anxiety, is it logical to condemn on the same score the pressed radiator?

GENERAL USE OF STEEL PIPE

It is safe to say that a very small proportion of the pipe used for connecting radiators is really wrought iron, although "wrought-iron pipe" is usually specified. Although Mr. T. N. Thomson's paper before the American Society of Heating and Ventilating Engineers last January has led to much discussion, no one has questioned his observation that of the samples sent to him from all over the country of "good old wrought-iron pipe," 80% proved to be steel.

On the subject of efficiency the original form of pressed radiation was defective because of the peculiarly shaped top to each section, which interfered with the free circulation of the air, and because in the light of more recent knowledge, insufficient space was allowed between the sections.

RADIATING EFFICIENCY OF CAST-IRON AND STEEL

As for the maintained superior radiating efficiency of cast-iron as compared with steel, Professor Carpenter, Professor Kent, Professor Allen, W. T. Monroe, M. E., and the many references quoted by these authorities incline to agree that the differences appearing between the radiating efficiency of various metals are due more to differences in surface, differences in sizes and shapes of the radiators tested and to different methods of tests, than to differences in metal.

Judging by various published tables and the extensive adoption of one-inch pipe for radiator service prior to the advent of cast-iron radiators, the most efficient proportion between containing capacity and heating surface of radiation is that of the one-inch pipe, very nearly one pint to the square foot. The average proportion with the steel radiator is just about one pint to the square foot, where-

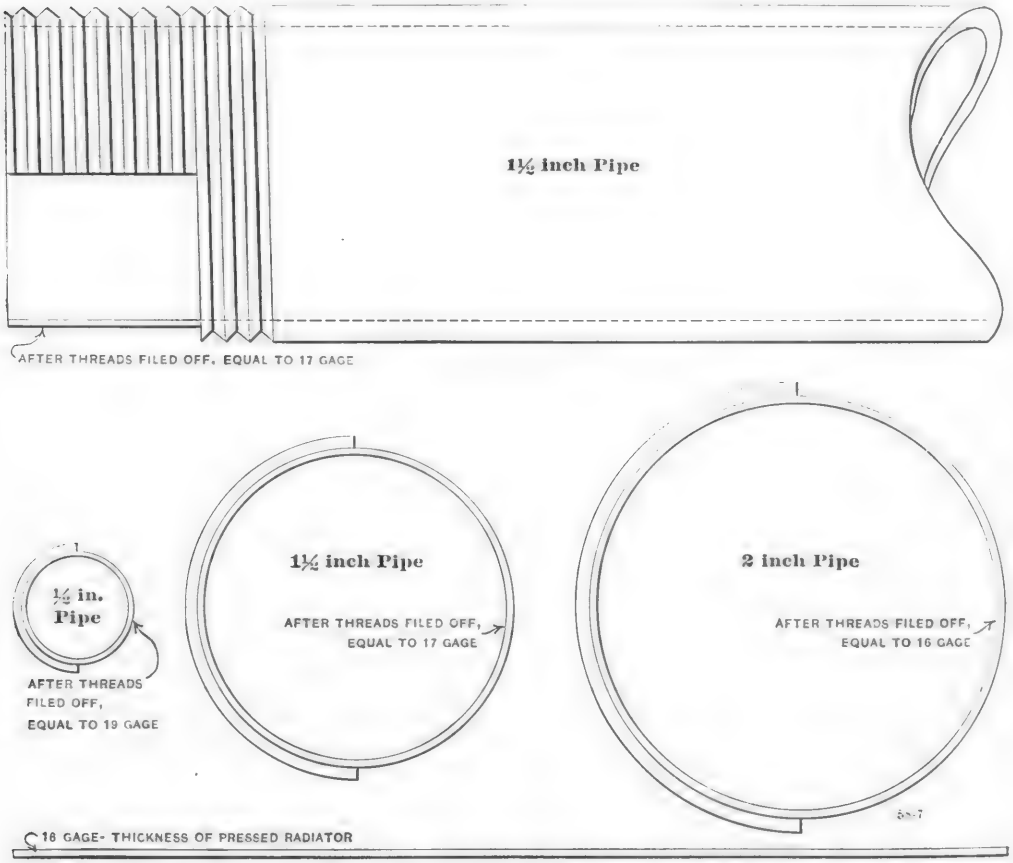

1½ inch Pipe
AFTER THREADS FILED OFF, EQUAL TO 17 GAGE
½ in. Pipe
AFTER THREADS FILED OFF, EQUAL TO 19 GAGE
1¼ inch Pipe
AFTER THREADS FILED OFF, EQUAL TO 17 GAGE
2 inch Pipe
AFTER THREADS FILED OFF, EQUAL TO 16 GAGE
16 GAGE- THICKNESS OF PRESSED RADIATOR

FIG. 1—ILLUSTRATING THE COMPARISON BETWEEN THICKNESS OF WALL OF VARIOUS-SIZED PIPES AFTER THREADING, WITH PRESSED RADIATOR WALL

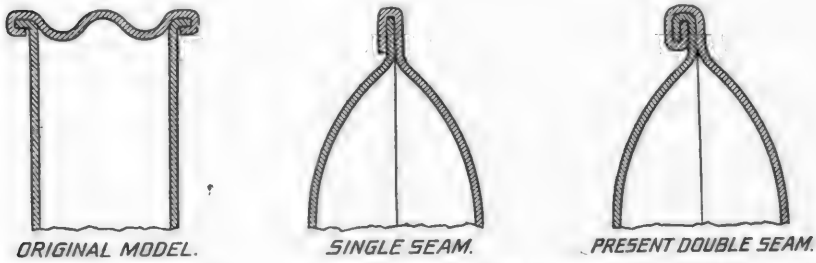


FIG. 2—EVOLUTION OF PRESSED RADIATORS ILLUSTRATED BY VERTICAL SECTIONS OF THREE MODELS. THE PRESENT DOUBLE SEAM MAKES AN ENTIRELY IMPERVIOUS POINT

as cast-iron radiators average about 50% greater. Besides this nearer approach to the ideal proportion of capacity to surface, there is less water and steam and far less metal to raise to the working temperature before effective heating is available, and to remain heated after the discontinuance of heat is desired; so that pressed radiators heat up more quickly when the valve is opened, and cool off more quickly when the valve is closed than cast-iron radiators. This positiveness of operation becomes an especially valuable consideration when heat is needed only for an hour of so a day—as in the spring and fall, when a little heat is required to take the chill out of the air, and during the mild winters that prevail in certain parts of the country.

The Weather for August

In the matter of temperature, August of 1908 averaged up closely with the Augusts of previous years, the temperature running a trifle lower, if anything, than usual.

NEW YORK

Highest temperature for the month, 91° on the 4th; lowest, 56° on the 27th; greatest daily range, 20° on the 30th; least daily range, 4° on the 26th. Mean temperature for the month, 72°, 1° below the mean of this month for 38 years. Total rainfall, 5.65 in., nearly 1 in. more than usual. Total wind movement, 7,139 miles, mostly from the south.

BOSTON

Highest temperature, 90° on the 14th; lowest temperature, 47° on the 29th; greatest daily range, 25° on the 30th; least daily range, 5° on the 27th. Mean temperature for the month, 60°, 1° lower than the mean of this month for 38 years. Total rainfall, 4.35 in., about ½ in. more than usual. Total wind movement, 7,013 miles, mostly from the southwest.

PITTSBURG

Highest temperature, 94° on the 4th; lowest temperature, 53° on the 21st; greatest daily range, 30° on the 2d; least daily range, 13° on the 16th. Mean temperature for the month, 72°, 1° below the mean of this month for 34 years. Total rainfall, 2.48 in., about ½ in. below normal. Total wind movement, 5,516 miles, mostly from the northeast.

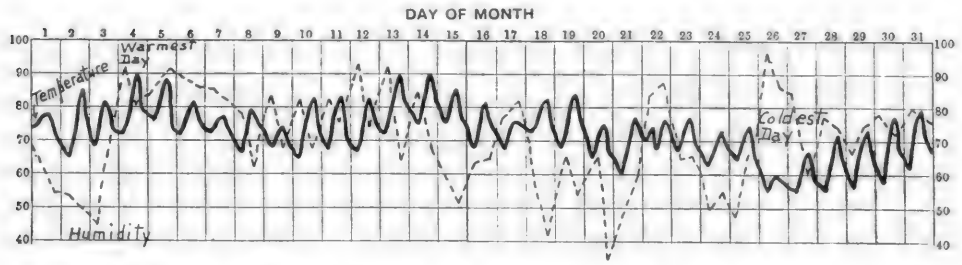
CHICAGO

Highest temperature, 96° on the 3d; lowest temperature, 58° on the 23d; greatest daily range, 23° on the 3d; least daily range, 6° on the 14th. Mean temperature for the month, 73°, 2° above the mean of this month for 38 years. Total rainfall, 6.35 in., which is over 3 in. above the average of this month for 38 years. Total wind movement, 9,089 miles, mostly from the northeast.

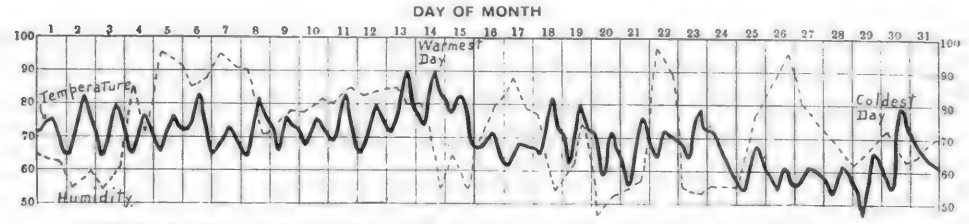
ST. LOUIS

Highest temperature, 98° on the 16th; lowest temperature, 59° on the 26th; greatest daily range, 23° on the 1st; least daily range, 5° on the 7th. Mean temperature for the month, 78°, which is the mean of this month for 36 years. Total rainfall, 1.55, nearly 1 in. less than usual. Total wind movement, 5,770 miles, mostly from the northeast.

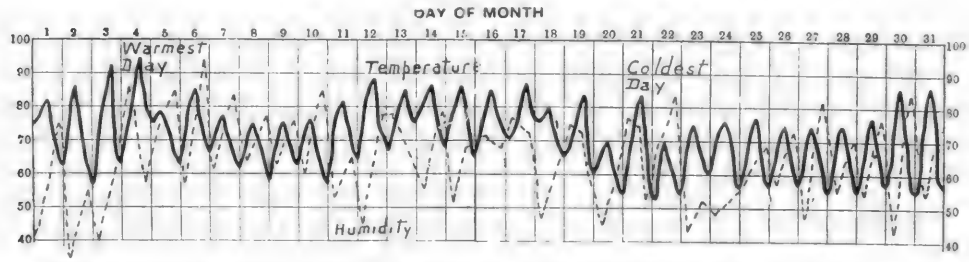
FIG. 3—SECTION OF 3-COL. PRESSED RADIATOR, SHOWING STEAM OR WATER SPACE AND PIPE CONNECTION



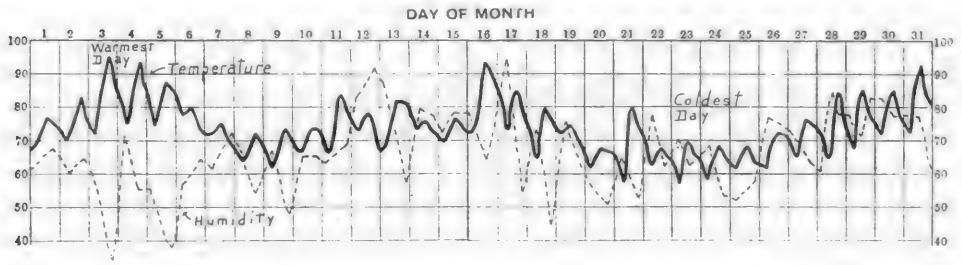
TEMPERATURE AND HUMIDITY RECORD FOR NEW YORK FOR AUGUST, 1908



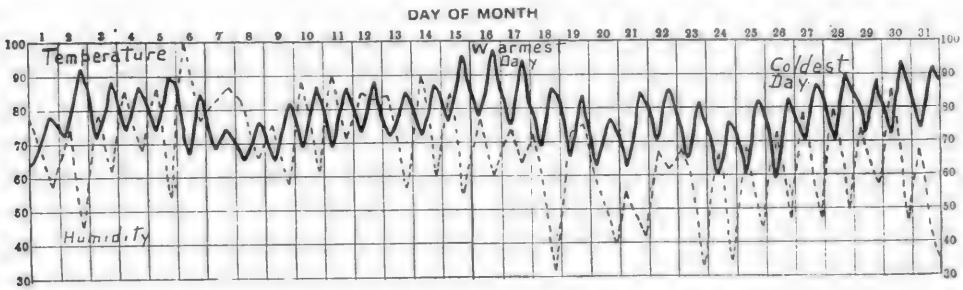
TEMPERATURE AND HUMIDITY RECORD FOR BOSTON FOR AUGUST, 1908



TEMPERATURE AND HUMIDITY RECORD FOR PITTSBURG FOR AUGUST, 1908



TEMPERATURE AND HUMIDITY RECORD FOR CHICAGO FOR AUGUST, 1908



TEMPERATURE AND HUMIDITY RECORD FOR ST. LOUIS FOR AUGUST, 1908

TRADE AND MISCELLANEOUS NOTES

Death

E. P. Allen, of the Dole Valve Co., Chicago, and the Allen & Magee Co., New York, died at his home in Jersey City, N. J., Aug. 15. Mr. Allen was widely known in the heating trade as the inventor of a number of heating specialties, including the E. P. Allen quick opening ball-bearing packless radiator valve, the Dole air valve and Dole automatic air and vacuum valve. He was formerly connected with the Norwall Mfg. Co., of Chicago. In 1906 he organized the Dole Valve Co., of Chicago, and a year later became associated, also, with Alonzo H. Magee, of New York, under the firm name of Allen & Magee Co., of which he was president and general manager. The latter company was formed for the purpose of promoting and distributing the various products of the Dole Valve Co. Mr. Allen leaves a widow and three daughters.

Miscellaneous Notes

American Federation of Labor has organized a metal trades department, with headquarters at Washington, D. C. Nine unions have qualified for membership in this department, including the International Molders' Union, International Association of Machinists, International Union of Stove Mounters and Steel Range Workers, Metal Polishers' Union, Buffers' and Platers' International Union, International Brotherhood of Blacksmiths and Helpers, International Brotherhood of Foundry Employees, International Association of Steam, Hot Water and Power Pipe Fitters and Helpers, International Union of Steam Engineers, Patternmakers' Union of North America. The president of the Metal Trades Department is James O'Connell, president of the International Union of Machinists. According to the constitution and by-laws of this new organization where there are three or more local unions of affiliated trades in any locality, they are to organize themselves into a local metal trades council.

National Association of Master Plumbers of Canada held its fourteenth annual convention in Montreal, Canada, Aug. 13-14, 1908. The following general

ENGINEERS AND STEAMFITTERS REQUIRE GOOD TOOLS

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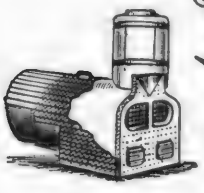

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ESTIMATES FURNISHED AND CONTRACTS EXECUTED.

100 NORTH MOORE ST, NEW YORK CITY.

officers were elected for the ensuing year: President, J. A. Gordon, Montreal; Vice-President, Joseph Laurier, Montreal; Treasurer, Harry Mahoney, Guelph; Secretary, H. W. Munday, Montreal.

Springfield Company, Springfield, O., is the name under which the People's Light, Heat and Power Co. and the Home Heating and Lighting Co., both of Springfield, have united their interests.

Cleveland, O. — The county building commission is planning to have the county and city of Cleveland combine in building a power house on the lake front to be used for heating and lighting the new county building, city hall and other structures that will be included in the group to be located on made ground at the foot of East Third street. It is also proposed to include in the plant a high-pressure pumping service.

Lincoln, Ill.—A franchise ordinance has passed the city council giving the Lincoln Railway and Light Co. the privilege to lay, operate and maintain a central station steam or hot water heating system in Lincoln. Rates are not to exceed the following schedule: When steam is furnished on a meter basis, 75c. per 1,000 lbs.; when furnished on a flat basis, 75c. per square foot of radiation, and for hot water, 25c. The plant must be completed and ready for service by October, 1909.

Modern Science Club, Brooklyn, N. Y., announces a lecture on the subject of "Central Station Design" to be delivered October 27, 1908, at its clubhouse, 125 South Elliott Place, by George A. Orrock, mechanical engineer of the New York Edison Company.

Manufacturers' Notes

United States Radiator and Boiler Co., Corry, Pa., announces the appointment as its sales manager of Ira C. Ewing, formerly of the Modern Heating Co., Wilkinsburg, Pa.

Smith & Anthony Co., Boston, Mass., announces the retirement of its president, William E. Smith. Mr. Smith has been president of the company since 1878. He is succeeded by W. B. Hathaway, who was formerly secretary.

H. W. Johns-Manville Co., New York, has opened a new branch at 85 Wellington St., West Toronto, Canada, under the firm name of Canadian H. W. Johns-Manville Co.

New Firms

Toronto Plumbing and Heating Co., Toronto, O., has opened a heating and plumbing jobbing and contracting business on West Main street.

Atlas Supply Co., Jeannette, Pa., is a new heating and plumbing and contracting firm. William J. Burkhardt, formerly of the Pennsylvania Supply Co., is one of the principals of the new company.

Deer & Over, Pittsburg, Pa., have opened a heating and plumbing business at 1,200 Chestnut street. The firm members are Charles C. Deer and Mr. Over, both of whom were formerly members of W. N. Sauer & Co., of Pittsburg.

O. W. Johnston, Marshall, Mo., has added a heating and plumbing department to his hardware business.

Greene Bros., Albert Lea, Minn., have opened a heating and plumbing business at 325 South Broadway.

J. A. Wheeler and C. S. Monroe, Fairbury, Neb., have organized a heating and plumbing business.

W. W. Campbell & Son, Boston, Mass., have organized a heating and power piping business at 17 Wendell street.

Business Chances

Galveston, Texas.—A total of $254,000 will be expended shortly on buildings at Fort Crockett, under the appropriation of $354,000 made by the last Congress. The

MASON
REDUCING VALVES
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Heating Systems
And for Every Service. Write for Catalogue
The Mason Regulator Co.
Boston, Mass.

remaining $100,000 will be devoted to installing heating plants, plumbing and for constructing roads, grades, etc.

Business Changes

Erie City Iron Works, Erie, Pa., manufacturer of boilers and feed water heaters, etc., is adding a $50,000 building to its plant, 60x400 ft.

Lyman D. Mills Co., Middletown, Conn., has been organized to take over the heating and plumbing business of the late Lyman D. Mills. The members of the firm are T. F. Sheehan, C. M. Cannon, and W. F. Bailey, all of Middletown.

New Incorporations

Indiana Lighting Co., Lafayette, Ind., is the title of a giant corporation recently formed with a capital stock of $4,500,000 to furnish light, heat and power to Fort Wayne, Bluffton, Montpelier, Lafayette, Logansport, Anderson, Wabash, Peru, Decatur, Geneva, Crawfordsville, Berne, Thorntown, Lebanon and Frankfort, in Indiana; and to Wapakoneta, Lima, St. Mary's, Celina, Greenville, North Mercer, Fort Recovery and Coldwater, in Ohio. The board of directors includes some of the most widely known men in the electrical world. They are James N. Wallace, Albert Tag, Franklin L. Babcock, Anthony N. Brady, Charles E. Dieterich, James P. Lee, Frank S. Hastings, Henry C. Paul and Samuel T. Murdock. Mr. Paul lives in Fort Wayne and Mr. Murdock in Lafayette. The remainder of the directors live in New York. Although the officers have not yet been elected, it is said that Mr. Dieterich will be the president of the new corporation and Mr. Murdock secretary and general manager. The articles of incorporation provide that light, heat and power may be supplied by means of artificial and natural gas, electricity, steam or hot water. The company is also authorized to manufacture, produce, transport, distribute and sell its product and to purchase, lease or otherwise acquire natural gas territory, gas wells, power plants and other necessary acquisitions. The capital stock is divided into 45,000 shares at $100 each.

Dallas Heat and Power Co., Dallas, Tex., capital $100,000, to supply heat to the public with compressed air used in connection with a patented invention known as the Butler crude oil burner. Incorporators: J. F. House, I. J. Willingham, J. W. Crisler, J. B. Adone, and A. C. Butler.

Quick Heater Co., Indianapolis, Ind., capital $25,000, to manufacture and sell instantaneous water heaters and other supplies. Directors: William E. Kurtz, John A. Kurtz and Harmon H. Fulton.

Rhode Island Humidifier and Ventilator Co., Providence, R. I., capital $50,000, to deal in air moistening and ventilating devices. Incorporators: James Kelley, Michael F. Kelley and Hugh F. Carroll.

Ross-Johnson Co., Bloomington, Ill., incorporated to conduct a general steam and hot water heating, plumbing and gas fitting business.

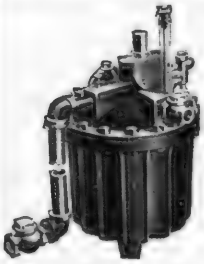
Cottier Ventilating Co., San Francisco, Cal. Capital stock, $75,000. Incorporators: K. C. Mioler, E. L. Furness, J. T. Breunan and D. I. Mahoney.

Kellar & Thompson, Covina, Cal., capital $50,000, to manufacture "KT" valves and gates and machinery for pipe molding.

Calmon Asbestos and Rubber Works of America, New York, capital $25,000, to manufacture heating and plumbing specialties. Incorporators: Edward K. Garcin, Rudolf Gaertner.

Acme Nipple Mfg. Co., Chicago, capital $5,000, to deal in heating and plumbing specialties. Incorporators: J. R. Griffiths, J. P. Glomb and W. S. Reid.

National Heating Co., Chicago, capital $4,000, to deal in heating specialties. Incorporators: A. J. Schmidt, P. L. McArdle and T. W. Prindiville.



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President

THOMAS F. RYAN
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White Boiler Feed Regulator Co., New York. Capital stock, $30,000. Incorporators: Martin L. Amann and George B. Munn, of Warren, Pa., and George H. Bates, of Jamestown, N. Y.

E. W. Hollister Co., Schenectady, N. Y., capital $25,000, to conduct a heating and plumbing business. Incorporators: E. W. Hollister, J. A. Tiedemann and H. L. Tiedemann, all of Schenectady.

Bentz System Co., New York, capital $100,000, to manufacture humidifying devices. Incorporators: Bernhard Greef, Harry Bentz and Gerhard E. H. Greef.

Kauffman Heating and Engineering Co., St. Louis, Mo., capital $15,000, to manufacture the Kinealy air washer and purifier. Incorporators: Sam. Kauffman and others.

Johnson-Washburn Co., Boston, Mass., capital $5,000, to conduct a heating business. Incorporators: John O. E. Johnson, Frank D. Washburn and Luther G. Dearborn, Jr.

Contracts Awarded

McGinness-Smith Co., Pittsburg, Pa., hot water heating $40,000 residence of H. S. Stewart.

M. J. Daly's Sons, Waterbury, Conn., heating St. Margaret's school at Middlebury.

George W. Wood, Lima, O., steam heating and plumbing addition to Lima Hospital in Lima.

O. F. Bennet & Co., Haverhill, Mass., heating plant for factory of J. B. Judkins & Sons Co., Merrimac, Mass.

William H. Seddon Plumbing Co., Columbus, O., hot water heating system for city prison and police headquarters in Columbus, for $3,390.

James P. Dwyer, Boston, Mass., heating and ventilating the new Shurtleff School, in Chelsea, Mass., at his bid of $19,330.

Fall River Steam and Gas Pipe Co., Fall River, Mass., heating new school building in Fall River, for $4,985.

Paul W. Schneider, Utica, N. Y., heating library building at Remsen, N. Y.

Lano & Irsfield, Browerfield, Minn., steam heating new school building at that place.

E. W. Hollister, Schenectady, N. Y., steam heating, ventilating and plumbing Nott street school, for $8,969; also similar contracts for Albany street school, Union street school and Park place school, at $8,494 each.

Otto Biefield & Co., Watertown, Wis., steam heating M. D. Wells Shoe Co. factory.

F. W. Barclay, Beatrice, Neb., heating, plumbing and lighting, etc., of the new high school building at that place. The contract amounts to $8,800.

H. G. Kaillies, Manitowoc, Wis., heating and ventilating public school building at Bullion, Wis.

Lewis & Kitchen, Kansas City, Mo., heating systems for Kansas avenue and Central avenue school buildings at Emporia, Kan. The bid totaled $2,300.

Charles E. Hasey & Co., Minneapolis, heating plant for the Albert Lea College at Albert Lea, Minn. The contract amounts to $15,875. A power plant will be built in a corner of the campus 76x39 ft., the engine room being 20x36 ft. The equipment will include two 60-in. boilers 16 ft. long. Heating mains will be run to the main building, Cargill Science Hall and the cottages.

Reliable Heating and Plumbing Co., Champaign, Ill., heating and plumbing new schoolhouse at Havana.

Evans & Hoefer Plumbing and Heating Co., Freeport, Ill., heating high school at Warren.

R. K. Anderson, Fort Scott, Kan., repairing boilers, heating plant and plumbing of post-office building at that place.

Martin & Wigman, Green Bay, Wis., heating school building at Mountain, Wis.; also heating high school building at Sturgeon Bay, Wis.

E. J. North, Yates, Ill., heating public school at that place

Justus Heating and Plumbing Co., Massillon, O., heating and ventilating new city hospital, in that city, for $6,500.

Dettmer & Hardwork, Slatington, Pa., steam heating and ventilating new high school building at Berlinsville.

E. Thompson & Co., Omaha, Neb., heating and plumbing Westside school building at Omaha for $4,040.70.

People's Light, Heat and Power Co., Springfield, O., heating contract for the Juvenile Detention Home at 5c. per 1,000 Watt hours.

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DRY STEAM—SAFETY—ECONOMY
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Wilson & Long, Hutchinson, Kan., heating Christian church at that place.

Marvin, Michel & Bradley, Manston, Wis., heating plant for store of the Montello Mercantile Co., at Manston.

Moline Heating and Construction Co., Moline, Ill., has been awarded the contract for the laying of the water mains in East Moline for the contract price of $19,980.87.

M. J. Gibbons & Sons, Dayton, O., heating county infirmary at their bid of $8,464. The Paul system will be used.

Woronocco Plumbing and Heating Co., Westfield, Mass., heating and plumbing new store and apartment block for J. M. O'Donnell.

Aetna Heating and Ventilating Co., New Britain, Conn., heating and ventilating Church street school building for $6,875.

F. & C. B. Nash Co., Dover, Me., heating and ventilating the Foxcroft school building.

Cleghorn Co., Boston, Mass., heating United States post-office in Boston for $40,000.

C. H. Goss Co., St. Johnsbury, Vt., heating and plumbing new jail building.

Taylor & Taylor, Dalton, Mass., heating and plumbing new armory building at Meriden, Conn.

Harcus & Lange, Detroit, Mich., heating and plumbing new Magdalen Building for the House of the Good Shepherd at Detroit.

George F. Grinnell, Jefferson, Ia., heating and plumbing public school building at Humboldt, Ia., for $4,297.

Exeter Machine Works Co., Exeter, N. H., heating and Ventilating Christ Church, Andover, Mass.; also heating Globe house in Andover.

Crain-Stuart Co., Springfield, O., heating and plumbing new Fairbanks office building at that place. 15,000 sq. ft. of radiation will be installed.

Jorgensen & Ohlsen, Jamestown, N. Y., heating two new school buildings at Cambridge Springs, Pa.

Wolf & Rushworth, Lake Charles, La., steam heating, plumbing, and wiring of new high school building at Jennings, La.

Chatfield & Armitage, Jamestown, N.Y., steam heating and plumbing new county court house at that place.

W. F. Sheahan, Topeka, Kan., heating and plumbing hospital for the Sisters of Charity. The work will amount to $15,500.

Sodemann Heat and Power Co., St. Louis, Mo., steam heating and ventilating high school building at Brookhaven, Miss.; also steam heating six-story mercantile building for the Altoona Investment Co.

Norwalk Heating and Lighting Co., Norwalk, Conn., steam heating, lighting and plumbing in N. Y., N. H. & H. R. R. building at Georgetown.

Spencer Plumbing Co., San Francisco, Cal., heating D. Samuel's Lace House Company's building in that city.

R. R. Moore, Wichita, Kan., heating Emerson School building at Wichita.

Jamieson-McKenney Co., Ithaca, N. Y., heating and plumbing fraternity building at Ithaca, N. Y.

Ideal Heating and Construction Co., Davenport, Ia., remodeling heating plant at St. Katherine's Hall, Davenport.

Ben Benson, Willmar, Minn., heating central school building at that place for $3,294.

J. E. Morrison, Crookston, Minn., heating school house at Lengley.

Huey Bros. Co., Boston, Mass., heating Edward Everett School building at Dorchester for $15,672; also St. Joseph's Church at Roxbury for $7,377, and the Everett Associates Building at Everett for $4,187.

A. M. Mitchell, Correctionville, Ia., heating parochial school building at Anthon, La.

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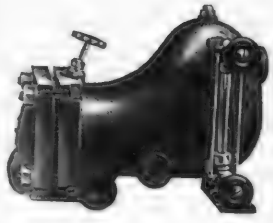

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W. B. Young Supply Co., Kansas City, Mo., heating administration building of the asylum at Parsons, Kan.

Claude R. Coles, Miles City, Mont., heating new school at Terry, Minn.

J. H. Roberts, Brookings, S. D., heating school building at De Smet, S. D.

Manuel Smith Heating Co., Minneapolis, Minn., heating new school at Delton, Wis.

H. Kelly & Co., Minneapolis, Minn., heating and plumbing new school building at Blackduck, Minn.

Fargo Heating and Plumbing Co., Fargo, N. D., heating Lincoln school building for $1,940.

Scott Heating Co., Oelwein, Ia., heating public school buildings at Fayette, Ia., for $2,110; also heating new school building at Elgin, Ia.

Columbus Heating and Ventilating Co., Columbus, O., heating new school buildings at Athens, O., for $1,550.

Conger & Newton, Macomb, Ill., heating high school building at that place for $1,792.60.

George Moore & Sons, Nashville, Tenn., heating, plumbing, electric wiring and gas fitting new public building at Paris, Tenn. The contract amounts to $25,175.

West Virginia Heating and Plumbing Co., Charlestown, W. Va., heating, plumbing and gas fitting Broadus Institute at Phillippi, W. Va.

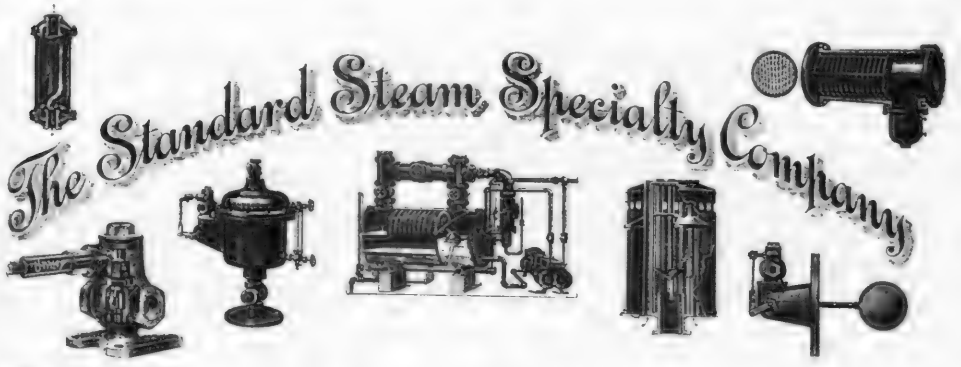
West End Heating and Engineering Co., Philadelphia, steam heating power plant for Trenton, N. J. Street Railway Co.

P. Feldman & Son, Brooklyn, N. Y., hot water heating Senate building at 394 Graham avenue.

George Kurtz, Iowa City, Ia., heating city hall for $1,675.

Manual for Engineers

"Tables and Other Data for Engineers and Business Men" is the title of a very full manual in vest pocket size, published by the University of Tennessee, Knoxville, Tenn. It contains 248 pages and sells for 50 cents a copy. The present edition is the eleventh and contains much new matter, including a carefully arranged four-place logarithm table, which for most engineering work is considered as satisfactory as a table of six or more places. The manual will be found of value to heating and ventilating engineers as it includes many tables frequently consulted by them. It is bound in limp leather with gilt edges.



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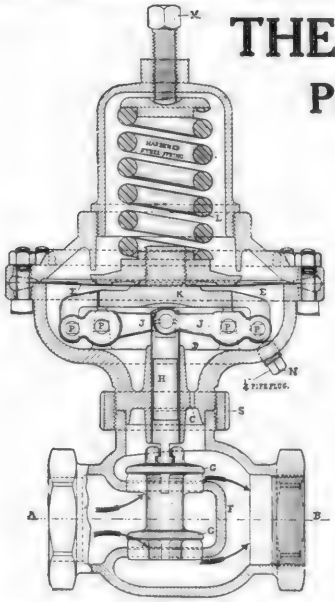

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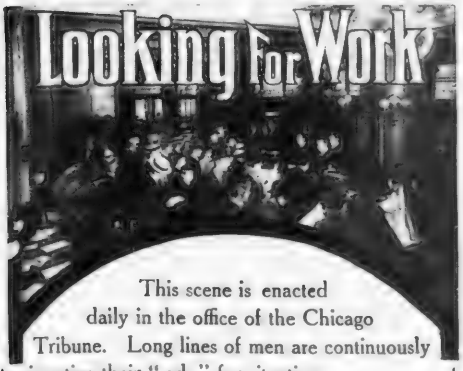

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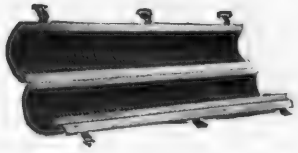

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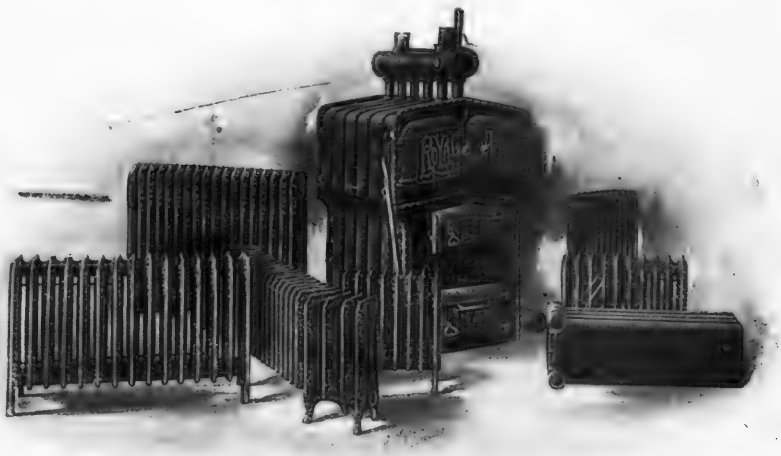

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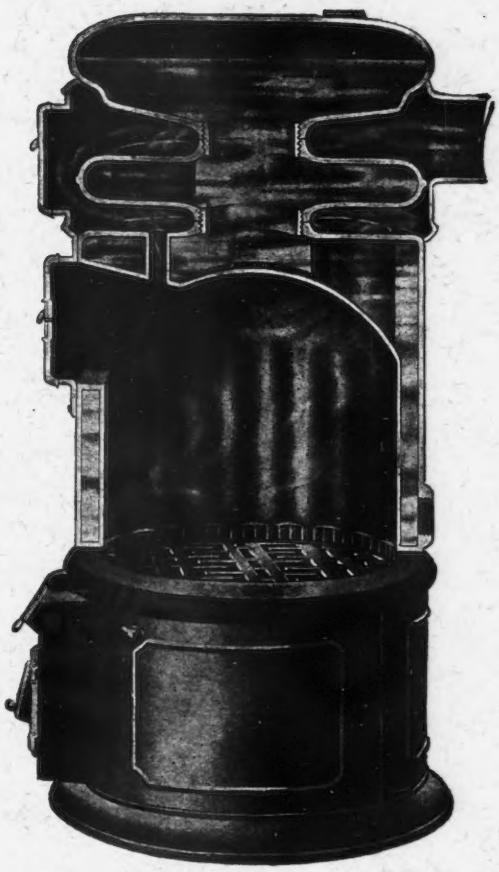

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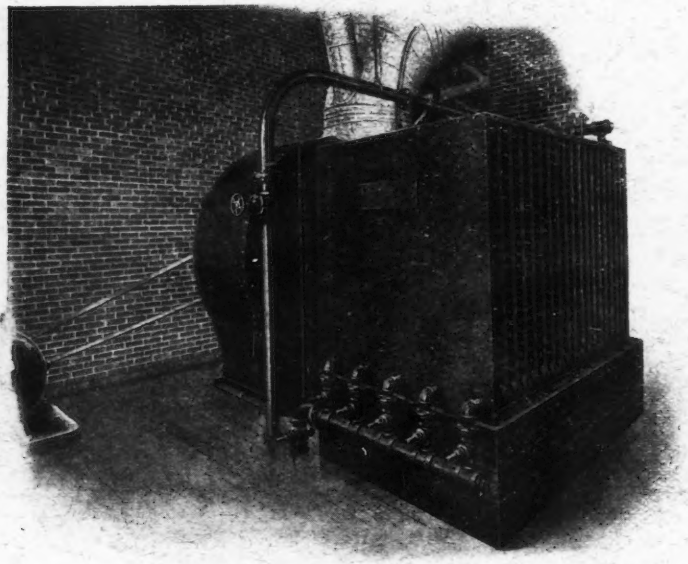

No matter how exacting the requirements, these heaters admirably fulfill every need. For churches, schools, banks, hospitals, asylums, hotels, theatres, etc., where heating and ventilation demands are unusual, the Vento Hot Blast Heater merits serious consideration. Send for new catalogue.

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